Labor Scarcity, Technology Adoption and Innovation: Evidence from the Cholera Pandemics in 19^{th} Century France*

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Abstract

To analyze the impact of labor scarcity on technology adoption and innovation, this study uses the differential spread of cholera across France in 1832, 1849 and 1854, before the transmission mode of this disease was understood. The results suggest that a larger share of cholera deaths in the population, which can be causally linked to summer temperature levels, had a positive and signif-icant short-run effect on technology adoption and innovation in agriculture but a negative and significant short-run impact on technology adoption in industry. These results can be explained by the positive impact of labor scarcity on human capital formation.

Keywords: Epidemics, Labor Scarcity, Technology Adoption, Technology-Skill Complementarity.

JEL classification: I15, N13, O33.

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1 Introduction

To explain technology adoption, theoretical studies have developed the macroeconomic implications of production factors which can be either complementary or substitute (see, e.g., Aghion and Howitt, 1992; Zeira, 1998; Howitt, 1999; Acemoglu, 2007, 2010; Alesina et al., 2018). If labor and technology are complementary factors of production, then labor scarcity, whereby skilled and/or unskilled workers are needed to operate machinery, is detrimental to technology adoption.[1] If they are substitute, then labor scarcity leads to high wages and is conducive to technology adoption. However, there is no clear empirical answer regarding the effects of labor scarcity on technology adoption because obtaining a quasi-experimental framework that could provide causal evidence has turned out to be challenging.

This study makes use of data about the cholera pandemics in 1832, 1849 and 1854 across France to provide reduced form estimates for the effect of labor scarcity on technology adoption and innovation.[2] In so doing, it asks the following questions: (i) is labor scarcity conducive to technology adoption in agriculture and in industry or not, i.e., are production factors in agriculture and in industry complementary or substitute? (ii) is labor scarcity conducive to technological innovation? and (iii) is labor scarcity conducive to technology adoption and innovation in both the short-run and the long-run?

19^{th} c. France appears well suited for such an empirical analysis. First, the country was hit harshly by the cholera epidemics: it lost 102,739 individuals in 1832, 102,500 in 1849 and 142,749 in 1854, i.e., about 1% of the population died over 22 years.[3] However some areas were hit more intensely than others. For instance, the department of Ariège in the South-West of France lost 4.2% of its population during the 1854 pandemic. Second, it was one of the first countries to experience the industrial revolution. Third, the French territory had been divided in small administrative divisions of nearly equal size in 1790 and thus, before the spread of cholera. During the period under study, there were 85 departments which were subdivided into 357 arrondissements: their average size was 6,000 km^2 and 660km^2

[1]Several studies (e.g., Kremer, 1993; Ashraf and Galor, 2011) noted that historically, technological innovation occurred in densely-populated areas.

[2]This paper thus differs from studies which use CES and/or Cobb-Douglas production functions to assess the rate of substitution between labor and technology. In this literature (e.g., Knoblach and Stöckl, 2019, for a recent survey), specific assumptions on estimation equations and technology dynamics have a substantial impact on the estimated parameters. We do not attempt to reproduce our main reduced form regression results with a CES production function given the specificities of our data as we discuss below.

[3]To put these figures in perspective, estimates suggest that the Spanish flu in France killed about 0.61% of the population after WWI (238,000 out of 39,108,000 inhabitants) while the Covid-19 pandemic had killed 0.19% by 31 December 2021 (123,805 out of 66,314,842 inhabitants) (Ansart et al., 2009).

respectively.

In the course of the 19^{th} c., scientists offered competing theories on the spread of cholera and its cure. Although English physician John Snow had already published his first findings in 1849, it was only in 1855 with the second edition of his book that he conclusively demonstrated the role of contaminated water in the spread of the disease (Snow, 1855). And while Italian scientist Filippo Pacini had isolated the Vibrio Cholerae Bacterium in 1854, it was only in 1884 that German scientist Robert Koch would identify the Vibrio Cholerae Bacterium as the source of the disease and subsequently provide a treatment (Koch, 1884). Scientists have, by now, identified the different modes of transmission of cholera (Glass and Black, 1992). In particular, for a country like France whose weather is not warm throughout the year, cholera is particularly prone to transmission in the summer and specifically, in regions which are humid. In such an environment, transmission is often possible because the Vibrio cholerae bacterium can survive for six to seven weeks on dry clothes which were previously damp and sweaty. In fact, because the basic rules of microbe transmission and social distancing were unknown at the time, cholera was often spread during funeral wakes when mourners would touch the body of the dead and his/her dry clothes, thereby leading to the mistaken belief that the disease spread through airborne "miasmas".

But even if the spread of cholera before 1855 was not understood and could not be prevented, it is possible to conjecture in hindsight that the diffusion of the pandemics was correlated with local characteristics. While our empirical strategy controls for time-invariant characteristics with fixed effects, it might be the case that cholera spread more easily in areas near rivers where population density increased between 1832 and 1854. Moreover, the relationship between labor scarcity and technology adoption may ultimately reflect the potential effect of institutional, geographical, and cultural characteristics on the joint evolution of the labor supply and technological progress. Given the potential endogeneity in the relationship between labor scarcity and technology, and in light of the historical evidence linking summer temperature levels and humidity to the spread of cholera in France (Delaporte, 1986; Bourdelais and Raulot, 1987), this paper uses the historical weather data of Luterbacher et al. (2004), Luterbacher et al. (2006) and Pauling et al. (2006) to establish the causal impact of the cholera on technology adoption. The empirical analysis shows that summer temperatures in 1832, 1849 and 1854 have a causal impact in the local intensity of cholera deaths in the population of each department. This finding is robust to using Acemoglu et al. (2020)'s maximum likelihood strategy that accounts for interpolation concerns in the measurement of temperature across geographic units. More generally, our results are robust to falsification tests showing showing that the share of cholera deaths cannot be explained by other seasonal temperature and rainfall levels in other years as well as to pre-trends tests for observable demographic and economic characteristics.

The results establish that in the short-run, a larger share of cholera deaths in the population had a positive and significant effect on technology adoption and innovation in agriculture but a negative and significant impact on technology adoption in industry. As such, our results suggest that labor and capital are substitute factors of production in agriculture and complementary in the industrial sector, in line with recent studies on the impact of labor scarcity that rely on policy variations in migration (e.g., Abramitzky et al., forthcoming; San, forthcoming). However our findings indicate that the effects of the cholera pandemics on technology adoption and innovation were quantitatively limited.[4] A department experiencing a median loss in population because of the cholera epidemics (0.057%) would have adopted 0.28 additional mechanized ploughs per day laborer over the following years but would have had 3.68 fewer steam-powered machines per worker in the year after each epidemic. These results are robust to accounting for spatial autocorrelation using Colella et al. (2020)'s approach as well as for heterogeneous treatment effects using the two-way fixed effects estimators of de Chaisemartin and D'Haultfoeuille (2020).

Moreover, our study suggests that the positive impact of labor scarcity on human capital accumulation can explain our main results. As population loss increased the expected returns to literacy and literate workers were sought out in industrial work (e.g., Katz and Margo, 2014; Atack et al., 2019; Franck and Galor, 2022), the rise in the share of literacy workers in the population offset the immediate negative effect of the population losses on technology adoption in industry. In parallel, this increase in literate workers, who would most likely avoid low-paying work in agriculture, fostered agricultural mechanization. Additional regressions show that this human capital channel for our results is robust to accounting for migration, urbanization, a cultural shift as proxied by a change in religiosity, fertility and nuptiality patterns as well as local financial intermediation.

This study is related to three strands of the economics literature but seeks to provide a different perspective. First, it is related to research on pandemics, income shocks and economic growth (e.g., Chakraborty et al., 2010; Adda, 2016; Rasul, 2020; Albanesi and

[4] It is possible that pandemics only have a major economic effect on economies when the death toll reaches a high threshold, e.g., when one third of the population died during the Black Death in the Middle Ages. However, since the 19^{th} c., no pandemic in countries out of the Malthusian trap has killed that many people. The public policy implications of our results therefore call for a careful approach as the economic consequences of pandemics may not be as disruptive as one would think.

Kim, 2021). Pandemics could spur growth by increasing available resources to surviving individuals, especially for economies at the Malthusian stage of development (Lagerlöf, 2003; Young, 2005; Siuda and Sunde, 2021).[5] However, it is difficult to ascertain the impact of pandemics for countries out of the Malthusian trap: while Ambrus et al. (2020) find a long-term impact of the 1854 cholera pandemic on poverty within London, studies on the 1918-1920 Spanish flu (e.g., Barro et al., 2020; Jordà et al., 2020; Lin and Meissner, 2020) concur that it had short-term negative effects but differ as to its actual long-run persistence.

Second, this paper is related to research seeking to explain technology adoption during the industrial revolution in the 19^{th} century (e.g., Mokyr, 2009; Aidt and Franck, 2015; Akcigit et al., 2017; Juhász, 2018; Caprettini and Voth, 2020). Research starting with Habakukk (1962) has argued that labor scarcity, and the ensuing high wages, led to the adoption of machinery. It is however unclear whether high wages in England and the USA actually stemmed from the relative abundance of coal or land, or from the presence of skilled workers with high levels of productivity(see, e.g., Kelly et al., 2014; Stephenson, 2018).

Third, this study is related to research assessing the impact of labor market conditions on the adoption of labor-saving technology: these include Acemoglu and Finkelstein (2008) on healthcare, Manuelli and Seshadri (2014) and Hornbeck and Naidu (2014) on agriculture, Lewis (2011) on manufacturing, Acemoglu and Restrepo (2022) on the link between demographic factors and technology adoption as well as Dechezleprêtre et al. (2019) on the effects of labor costs on automation.[6] In this respect, most of the recent literature on labor scarcity takes advantage of changes in migratory policies in the short- and mid-run (e.g., Moser et al., 2014; Clemens et al., 2018; Abramitzky et al., forthcoming; San, forthcoming). This study however seeks to give a different perspective by providing causal evidence over a 50-year period for the effects of labor scarcity caused by a disease whose transmission mode was then not understood and which had no cure.

The remainder of this article is as follows. Section 2 presents the data and Section 3 the empirical strategy. Section 4 discusses the results. Section 5 shows that the increase in human capital explains our main results and establishes that alternative mechanisms do not provide convincing explanations. Section 6 concludes.

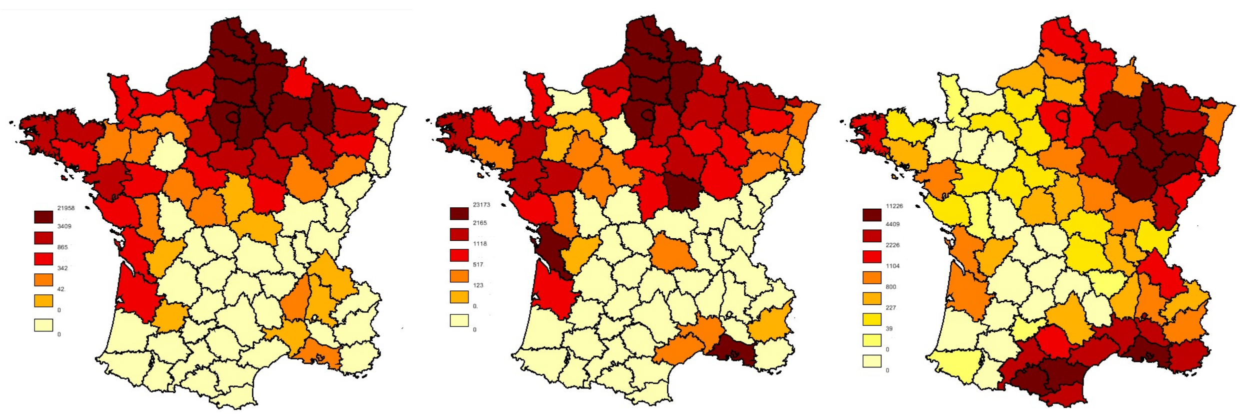
[5]The Black Death in Western Europe seems to have been conducive to growth in the long-run but its effects were different in Eastern Europe (e.g., Voigtländer and Voth, 2013; Jedwab et al., 2019).

[6]Other studies dealing with the relative scarcity of production factors on technological adoption include Newell et al. (1999) and Hassler et al. (2021) on the rise of energy prices and scarce natural resources as well as Hanlon (2015) on cotton.

2 Data

The dataset comprises information on the 85 departments and 357 arrondissements in mainland France, as well as on individuals living across the country, during and after the 1832, 1849 and 1854 cholera pandemics.[7] As we note below, information is sometimes missing for some outcome variables immediately after 1832 and we are therefore compelled to restrict the sample to the aftermath of the 1849 and 1854 pandemics. Table A.1 reports the descriptive statistics for the variables in the empirical analysis across the departments and arrondissements as well as for the variables used in the individual-level analysis. Tables A.2 and A.3 provide descriptive statistics for the additional variables employed in falsification tests and robustness analyses.

2.1 Cholera Outbreaks



1832 1849 1854

Figure 1: Cholera Deaths, 1832, 1849 & 1854

To build the main explanatory variable on the intensity of cholera outbreaks in 1832, 1849 and 1854, the study uses the official statistics provided by the French government on the share of cholera deaths within the population of each department (France, 1862). As can be seen in Figure 1, the three cholera pandemics mainly affected the north of France and the

[7]The analysis is restricted to mainland France and excludes Corsica where no death from cholera was recorded in 1832 and 1849, and where there were only 220 cholera deaths out of 236,251 inhabitants in 1854 (0.09% of the population). Moreover, three new departments (Alpes-Maritimes, Haute-Savoie and Savoie) were added to France in 1860. Since they were not part of France during the 1832, 1849 and 1854 pandemics, they are excluded from the analysis.

Atlantic Coast. The south of France was only hit harshly in 1854.[8] Only 11 departments located in the hinterland south-west of the French territory were spared in the three cholera outbreaks (Cantal, Corrèze, Creuse, Dordogne, Gers, Landes, Lot, Lozère, Hautes-Pyrénées, Vienne and Haute-Vienne).

Here two remarks are important. First it must be noted that before 1855, the transmission mode of the cholera had not been conclusively established. At a time where basic knowledge about microbes was just being discovered, some scientists were mistakenly arguing that there were airborne "miasmas"which explained the diffusion of the disease. As such, avoiding polluted water sources, as well as proper hygiene and social distancing, did not play a role in the behavior of individuals: since no-one knew how the disease spread, it was not even clear that running away from areas affected by the cholera could offer any protection.[9] Second, the disease was a problem for the central State, the local governmental authorities, the Church as well as the local associations. However there was no health policy which any government or organization could implement to stop the disease.

Table 1: The Distribution of the Percentage of Cholera Deaths in the Population across French Departments in 1832, 1849 & 1854

	Mean	25^{th}	50^{th}	75^{th}	90^{th}	99^{th}
1832	0.26	0	0.01	0.26	0.86	2.35
1849	0.20	0	0.02	0.22	0.88	1.70
1854	0.46	0.009	0.16	0.61	1.36	4.20
All Years Combined	0.31	0	0.06	0.30	0.90	2.84

Note: This table reports descriptive statistics for the percentage of cholera deaths in the population across the 85 French departments in 1832, 1849 & 1854. The total French population amounted to 32,443,430 inhabitants in 1832, 36,910,360 in 1849 and 35,782,708 in 1854.

As can be seen in Table 1, the distribution of cholera deaths within the population of each department is skewed: the 25^{th} percentile is equal to 0, the median 0.057%, the 75^{th} percentile 0.30% and the 99^{th} percentile 2.84%. This reflects the fact that the disease reached most departments at least once in either 1832, 1849 and 1854, but only a few were hit harshly. Nonetheless, 20 departments lost more than 1% of their population in at least one of the three outbreaks.

[8]Anecdotal evidence suggests that each time, the cholera came by boat from England. It only spread to the south-east of France in 1854 because of the French soldiers who embarked from the southern harbors of Toulon and Marseille to fight the war in Crimea.

[9]The French population soon came to refer to the cholera as the "blue fear"(peur bleue) because of the blue coloration that the faces of sick individuals would take just before dying. The expression "peur bleue"is still commonly used in French and refers to something which is terrifying.

Table 2: Share of Cholera Deaths in Population by Gender and Age in 1854

Panel A. Test of means: age groups across gender

	(1) Female	(2) Male	(3) p-value
All	0.0047	0.0045	0.818
	[0.008]	[0.008]	
Age 0-20	0.0031	0.0032	0.916
	[0.0005]	[0.0006]	
Age 20-40	0.0032	0.0031	0.927
	[0.0006]	[0.0006]	
Age 40-60	0.0059	0.0058	0.946
	[0.001]	[0.001]	
Age 60 and above	0.012	0.011	0.658
	[0.002]	[0.002]	

Panel B. Test of means: across age groups for same gender

	(1) p-value Female Age 0-20		(2) p-value Male Age 0-20
Female Age 20-40	0.626	Male Age 20-40	0.452
Female Age 40-60	0.446	Male Age 40-60	0.703
Female Age 60 and above	0.525	Male Age 60 and above	0.417

Note: This table shows that the share of cholera deaths was not statistically different across the population of departments by age or gender. Standard deviations in brackets in Columns (1) and (2) of Panel A.

Tables 2 and 3 provide additional descriptive statistics and tests regarding the share of cholera deaths in the population. Table 2 distinguishes between the gender and age of the victims during the 1854 pandemic while Table 3 focuses on the share of victims by distinguishing departments by their mean and median population in each of the three pandemics.

The tests of means reported in both Tables 2 and 3 are never significant, thereby alleviating concerns that some sections of the population would be more (or less) likely to die from exposure to the cholera. In particular, the tests in Table 2 suggest that our results cannot be driven by the gender and/or age of the cholera victims within the population of the departments hit by the cholera while those in Table 3 indicate that they cannot be driven by the size of the departmental population and hence by the propensity of the victims to inhabit urban or rural departments.

Table 3: Share of Cholera Deaths in Population by Population Density, 1832, 1849 & 1854

Panel A. Test of means: Mean Population Density

	(1) Below Mean Population Density	(2) Above Mean Population Density	(3) p-value
1832	0.0276	0.0288	0.391
	[0.0007]	[0.0013]	
1849	0.0260	0.0268	0.444
	[0.0005]	[0.0011]	
1854	0.0303	0.0275	0.160
	[0.0014]	[0.0011]	

Panel B. Test of means: Median Population Density

	(1) Below Median Population Density	(2) Above Median Population Density	(3) p-value
1832	0.0278	0.028	0.756
	[0.0009]	[0.0010]	
1849	0.0256	0.0271	0.155
	[0.0005]	[0.0009]	
1854	0.0303	0.0280	0.239
	[0.0017]	[0.00097]	

Note: This table shows that the share of cholera deaths was not statistically different in departments with high or low population density. Standard deviations in brackets in Columns (1) and (2).

It is worth noting that there were additional cholera outbreaks in 19^{th} c. France, i.e., in 1884 and 1892. However, they occurred after 1855, when the transmission mode of the cholera had been finally established by Snow (1855). As a result, it is preferable to restrict the main analysis to the pre-1855 cholera outbreaks: this avoids endogeneity concerns that specific areas might become more efficient than others in preventing the spread of the disease once the mode of contagion was known. In this respect, we show in Table C.1 that the spread of cholera before 1855 was not correlated with its spread in 1884 and 1892 whose consequences were more limited because local authorities then understood and could prevent the diffusion of the disease. Table C.2 further shows that the 1832, 1849 and 1854 cholera pandemics were not correlated with the various causes of deaths in each department in 1855. Moreover, Tables C.3 and C.4 show that cholera pandemics in 1832, 1849 and 1854 are not correlated with the spread of illnesses before and after the 19^{th} c.: there is no correlation with the number of towns hit by the spread of the plague in the 18^{th} c. in each department, or with the spread of viral diseases (flu, acute diarrhea and chicken pox) in 1992, 2009 and 2014, i.e., 160 years later.

2.2 Summer temperature in 19th century France

As established by modern research (e.g., Glass and Black, 1992), the Vibrio Cholerae Bacterium quickly spreads in humid environments where temperatures are above 15 degrees Celsius. This implies two predictions for the diffusion of cholera in France. First, cholera mainly spreads during the summer because this is the season when temperatures in France are above 15 degrees Celsius for a long time period. Second, cholera is more likely to spread in the North than in the South of France because relative humidity is always higher in northern areas where temperatures are always relatively lower. While this second point might seem slightly counter-intuitive to the reader because humans feel humidity more accurately (and hence experience more discomfort) at higher levels of temperature, it is actually the case that relatively lower temperatures entail more relative humidity because they enable for less water evaporation (Wallace and Hobbs, 1977; Lutgens and Tarbuck, 2015). In the case of France, the regression results in Table B.1 use modern weather data from 42 weather stations in 2018 and establish that lower temperatures are indeed associated with higher relative humidity, accounting for weather station fixed effects as well as month-, day- and hour- fixed effects.[10]

Given the properties of the Vibrio Cholerae Bacterium and the historical context, our identification strategy predicts that (1) temperatures in the summer of 1832, 1849 and 1854, and not in any other season or in any other year, are significantly correlated with the spread of cholera because this is the only time period where temperatures remain above 15 degrees Celsius and that (2) summer temperature levels in 1832, 1849 and 1854 would be negatively correlated with the spread of cholera because northern French departments experienced relatively lower temperatures, and hence more relative humidity, than southern departments. Anecdotal evidence on the monthly spread of cholera in 1854 seems to support this prediction: Figure 2 shows that the disease spread from the north of the country and claimed the highest number of victims in July, August and September.

[10]The negative correlation between temperature and relative humidity is not specific to France. For instance, Huang et al. (2019, Table 1) report that in China, where temperatures in the North are lower than in the South, there is a negative correlation between mean temperature and relative humidity throughout the year that is only significant at the 5% level during the summer. For the sake of the argument, it should also be noted that the Sahara desert is located to the South of the Mediterranean sea and that this desertic area is dryer than the coastal Mediterranean areas of North Africa.

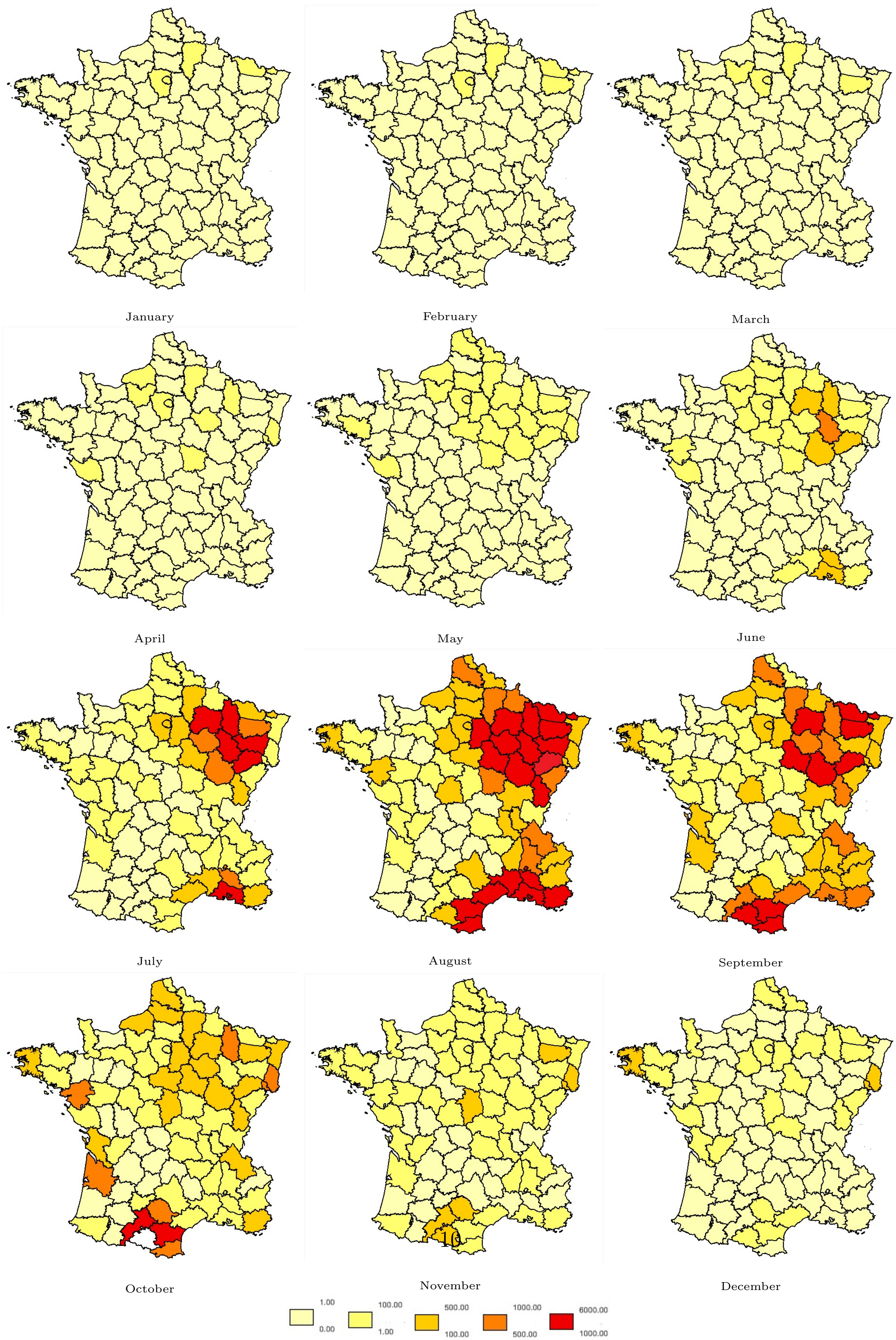
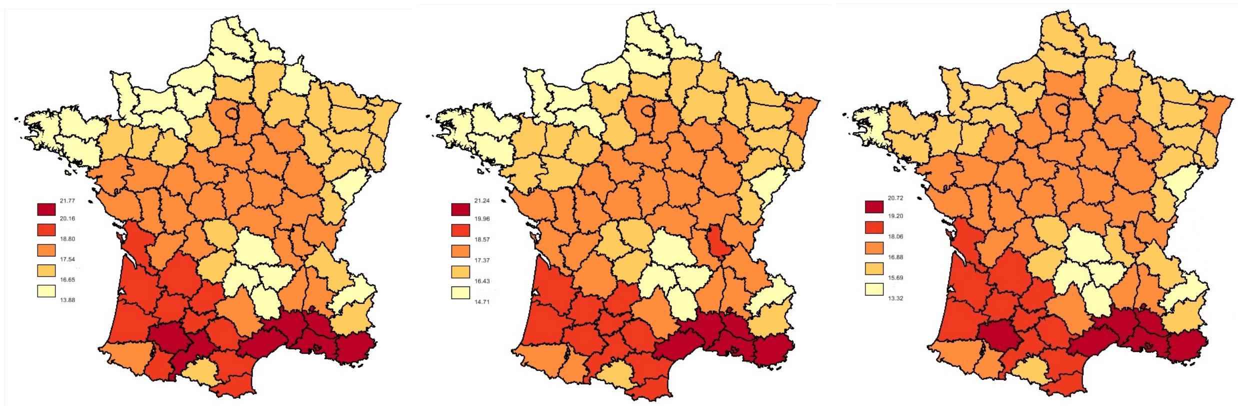


Figure 2: Cholera Deaths: January-December 1854



1832 1849 1854

Figure 3: Summer Temperature, 1832, 1849 & 1854

Our study relies on the historical weather data of Luterbacher et al. (2004), Luterbacher et al. (2006) and Pauling et al. (2006). These data were reconstructed using various sources such as lake sediments and tree rings as well as historical records for every season over the 1500-1900 period at a resolution of 0.5 by 0.5 decimal degrees. There are therefore concerns about measurement error and the interpolation of climatic data over departments, i.e., two cells per department on average. Still Luterbacher et al. (2004), Luterbacher et al. (2006) and Pauling et al. (2006) show that the quality of the data improve over time, especially from the end of the 18^{th} c. onward. Figure 3 maps those data for the summers of 1832, 1849 and 1854 and shows that temperature levels were relatively lower in the north than in the south of France during each of those summers.

Table 4: Summer Temperatures across French Departments in 1832, 1849 & 1854

	Mean	Std. Dev.	Min	Max
Summer Temperature 1832	17.72	1.43	13.88	21.77
Summer Temperature 1849	17.46	1.30	14.71	21.24
Summer Temperature 1854	17.15	1.23	13.32	20.72

Note: All variables have 85 observations. Source: Luterbacher et al. (2004), Luterbacher et al. (2006) & Pauling et al. (2006).

It is worth noting that summer temperatures in 1832, 1849 and 1854 were rather mild. As the descriptive statistics in Table 4 indicate, the average summer temperatures in 1832, 1849 and 1854 were around 17C, ranging from 13.3C to 21.7C. In other words, as we show in the robustness checks in the Appendix and in particular in Table D.4, summer temperature levels, but not summer temperature shocks, explain the local spread of cholera.

2.3 Measures of technology adoption and human capital

2.3.1 Technology adoption, wages and production in agriculture and industry

This study relies on the governmental surveys of agriculture carried out in 1852 and 1862 (France, Ministère de l'agriculture du commerce et des travaux publics, 1852, 1862). They provide department-level information on the number of agricultural day laborers and their wages, as well as agricultural tools and cereal production (millet, oats, rye and wheat). It is worth noting that, in line with the historical evidence (e.g., Agulhon et al., 2003), the descriptive statistics in Table A.1 show that there were more mechanized ploughs than day laborers: the average number of mechanized ploughs per day laborer in our sample is 2.80, with a standard deviation of 3.17. This is because the majority of landowners in 19^{th} c. France were small farmers who were themselves engaging in agricultural work and who would only hire day laborers during the harvest season.[11]

Furthermore, the empirical analysis takes advantage of the data on the French mining industry in the successive volumes of the *Statistique des Mines*: this official governmental publication provides information on the types of machines, the production of coal and peat, as well as the number and wages of workers working inside the mines. While the department-level data in the *Statistique des Mines* are restricted to one industrial sector, they are available every year from the late 1830s onwards and pertain to an industry which had used steam engines since the 18^{th} c. (Woronoff, 1994). These data thus enable a refined analysis of the short- and long-run effects of labor scarcity on technology adoption.

In addition, the study uses the governmental surveys of the French industries which were carried out in 1839-47 and 1860-65 at the arrondissement level. For firms in the textile sector, which was the other leading industrial sector in 19^{th} c. France, they provide information on water-powered, wind-powered and steam-powered machines as well as on wages and workers. A drawback of these surveys is their lack of consistency which prevents us from using them in a panel data setting: the 1839-47 survey reports data on the number of machines while the 1860-65 reports data on the horse power of machines.

A potential concern for our analysis is that the prices of tools in agriculture and industry would be different, thereby driving mechanization in one sector at the expense of the other. Anecdotal evidence (Désert, 1984, p.206) suggests that both industrial and agricultural tools

[11] It is beyond the scope of the article to discuss why there were few large landowners and many small farmers in 19^{th} c. France. French historiography still debates whether 18^{th} c. France was already characterized by the presence of small landowners or whether the policies of the 1789 French revolutionaries led to the dismemberment of many large land estates (see, e.g., Bodinier and Teyssier, 2000)

were expensive during our sample period and were either bought by a rich entrepreneur and/or landlord, or by a cooperative of small farmers .[12] In any case, to assuage concerns regarding the prices of machinery in agriculture and industry, we run in Table 5 a test of means on the prices and tariffs levied on imports of steam-powered engines, other industrial machines as well as scythes (a basic agricultural tool) over the 1827-1856 period. The p-values of the tests show no difference between the value of those imported goods, suggesting that price differences could not have constrained French producers to invest in agriculture or in industry.

Table 5: Value of Imported Steam-Powered Machines, Other Machines & Scythes, 1827-1856

(1)	(2)	(3)
Steam-Powered Machines	Other Machines	p-value
878.7	630	0.284
[202.5]	[91.5]	
(4)	(5)	(6)
Steam-Powered Machines	Scythes	p-value
878.7	851.7	0.904
[202.5]	[817.8]	

Note: This table presents test of means showing that there was no statistically significant difference in the price of imported steam-powered machines, other machines & scythes, 1827-1856. Standard deviations in brackets.

2.3.2 Technological innovation

Table 6: Categories of Patents

1.	Agriculture, milling, bakery, viticulture	2.	Agricultural hydraulics, watercourses, irrigations, artesian wells
3.	Railways, steam engines, engines	4.	Textile materials
5.	Machines and tools	6.	Navigation
7.	Constructions, carpentry	8.	Metallurgy, mining
9.	Hardware, plumbing, locksmith, cutlery	10.	Bodywork, carpentry, saddler, harness, brushwork
11.	Artillery	12.	Precision instruments, watchmaking, physics, surgery
13.	Ceramic, brickyard, glass works	14.	Chemical products and food substances
15.	Lighting and heating	16.	Clothing
17.	Fine arts, music, engraving, painting, lithography, typography	18.	Paper, Binding, Parisian Articles and Stationery
19.	Leather and skins	20.	Miscellaneous items

To test the hypothesis that labor scarcity spurred technological innovation, this study takes advantage of the data on patents from the French Institute for Intellectual Property (Institut National de la Propriété Intellectuelle) which was established in 1791. Since the patent

[12] For instance, in the 1830s-1850s, French-made water pumps used in factories in the Seine department cost between 400 and 2400 francs while in the Normandie region, threshing machines cost between 500 to 1600 francs (Brocchi, 1834; Désert, 1984; Dupré, 1993). For the sake of comparison, the average daily wage of an agricultural day laborer in our sample is 1.81 francs.

documents provide the purpose of the invention as well as the location of the inventor, it is possible to determine whether local labor scarcity triggered more innovation. Furthermore, the patents are listed in 20 categories shown in Table 6, thus enabling us to examine which sectors of the French economy spearheaded innovation in the wake of the cholera pandemics.

2.3.3 Human capital: literacy and schooling

The empirical analysis explores potential channels which could have fostered technology adoption in the aftermath of each cholera outbreak. Human capital could be such a channel, especially in light of recent studies which highlight the complementarity between education and technological change during the 19^{th} century (e.g., Katz and Margo, 2014; Atack et al., 2019; Franck and Galor, 2022).

For this purpose, the empirical analysis uses individual data from the *Enquête des 3000 familles* (Survey of the 3000 Families). This survey follows during the 19^{th} c. men and women from families whose last name starts by the three letters TRA. It provides information on their ability to sign their wedding licenses, as opposed to mark it with a cross, as well as on their birth year and birth department.[13] It also provides this same information for their spouses (whose last name does not start with these three letters).[14] Furthermore, in additional tests, we use the data of the *Enquête des 3000 familles* to assess the impact of the cholera on the age at marriage and on inheritance value.

Moreover, the empirical analysis relies on governmental data on the departmental shares of literate individuals among the French army conscripts, i.e., 20-year old men reporting for military service in the area where their father lived (France - Ministère de la Guerre, 1839-1937). These yearly data are not subject to selection bias because every Frenchman had to report for military service, although changes in conscription rules meant that every man did not eventually serve during the 19^{th} century (Crépin, 2009).

The empirical analysis also uses various measures of formal education at the department level from the *Statistique Générale de la France*. These data pertain to primary school attendance as well as to spending on primary schooling by the three tiers of the French government (communes, departments and the central State). They also provide information on courses for male and female adults and apprentices, as well as public spending on these

[13]Arguably, signing a wedding license provides a lower bound on literacy. It does not fully assess the ability to read and write.

[14]There might be concerns with respect to this dataset and its representativeness of the whole French population in the 19^{th} century. However Abramitzky et al. (2011) show that it is representative of nuptiality patterns while Daudin et al. (2019) find it to map accurately the patterns of internal migration.

courses for men (the data on public spending for the courses for women are not available in the time frame of our study). These courses for adults and apprentices can be thought of as the 19^{th} c. equivalent of workers' retraining classes insofar as they sought to provide basic technical knowledge and literacy skills (Marchand, 2005).

2.4 Characteristics of departments

The empirical analysis controls for the characteristics of departments that may be correlated with the adoption of new technology. These time-varying characteristics might actually be viewed as "bad controls" in the terminology of Angrist and Pischke (2008) as they could be correlated with the spread of cholera and the adoption of new technology.

First, we use Bazot (2014)'s data on the GDP per capita of each department. These data are reconstructed from official documents and provide a measure of local income.

Second, we control for the possibility that summer rainfall shocks might have contributed to the diffusion of the cholera since this disease spreads in humid environments. For this purpose, we use the historical weather data of Luterbacher et al. (2004), Luterbacher et al. (2006) and Pauling et al. (2006) to define a measure of seasonal rainfall shocks $R_{s,d,t}$ in season s in department d in year t such that $R_{s,d,t} \equiv \left[(\mu_{s,d,t} - \mu_{s,d})/\sigma_{s,d}\right]^2$ where the average rainfall $\mu_{s,d,t}$ is standardized by mean $\mu_{s,d}$ and standard deviation $\sigma_{s,d}$ of rainfall in each department. In what follows, both $\mu_{s,d}$ and $\sigma_{s,d}$ are computed over the 25-year period before each pandemic but additional regressions available upon request show that our results are also robust to using 10-, 15- and 20-year periods before each pandemic.

Finally, as discussed in detail below, the empirical strategy relies on a panel data approach with fixed effects that account for the time-invariant characteristics of the administrative areas. It is however possible that some time-invariant characteristics might have a different impact over time, especially if they are correlated with technology adoption. For this purpose, our empirical analysis includes interaction variables between year-fixed effects and specific geographic variables whose impact might have changed over time. These are the administrative areas' share of carboniferous area (Fernihough and O'Rourke, 2021), their land suitability (Ramankutty et al., 2002) as well as dummies indicating their location on the border with a foreign country and on the seashore.

3 Empirical strategy

The empirical analysis examines whether areas which lost a large share of their population during cholera outbreaks, and where consequently, labor scarcity became more acute, experienced greater adoption of labor-saving technology in the agricultural and industrial sectors. A priori, it is unclear whether production factors in agriculture and industry are complementary or substitute. It is also unclear what the dominant effect of labor scarcity on wages and production is in a general equilibrium framework. On the one hand, labor scarcity increases wages, and so does the adoption of machines which increases the productivity of workers. On the other hand, the adoption of machines could also lower wages. Furthermore, if production factors are complementary, labor scarcity would decrease production. However if production factors are substitute, then technology adoption is a cost-cutting measure: producers may choose to increase production, but may also produce the same quantity at a lower cost, or may even decrease production if demand has declined.

3.1 Empirical model

The empirical specification can be presented in two stages and estimated with 2SLS. The second stage can be written as

$$Y_{it} = \alpha_i + \alpha_t + \beta_1 C_{it} + \beta_2 \boldsymbol{X'_{it}} + u_{it}, \tag{1}$$

where Y_{it} is one of our measures of technology adoption and innovation in administrative area i in year t, C_{it} is the share of deaths caused by the cholera pandemics within the population of administrative area i in year t, $\boldsymbol{X'_{it}}$ is a vector of geographical and pre-industrial economic characteristics of administrative area i in year t, α_i and α_t are administrative-area- and year-fixed effects while u_{it} is an i.i.d. error term for administrative area i in year t.

In the first stage, C_{it} is instrumented by T_{it}, which represents summer temperature levels in administrative area i in year t

$$C_{it} = \gamma_i + \gamma_t + \delta_1 T_{it} + \delta_2 \boldsymbol{X'_{it}} + v_{it}, \tag{2}$$

where $\boldsymbol{X'_{i}}$ is the same vector of geographical and economic characteristics of administrative area i in year t used in Equation 1, γ_i and γ_t are administrative area- and year-fixed effects while v_{it} is an i.i.d. error term for administrative area i in year t.

3.2 Summer temperatures and cholera deaths in the population: first-stage regression results and tests for pre-trends

3.2.1 First-stage regression results

Table 7: Summer Temperature Levels and Share of Cholera Deaths in the Population

	(1)	(2)	(3)
First stage: the instrumented variable is Share of Cholera Deaths in Population			
Summer Temperature	-0.118***	-0.141***	-0.140***
	[0.0271]	[0.0303]	[0.0308]
	{0.044}***	{0.058}**	{0.061}**
1st stage F-stat	19.012	21.652	20.788
Moran I	-0.008	-0.008	-0.008
Moran I p-value	0.212	0.209	0.210
Department and Year Fixed Effects	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes
Geographic Controls * Year Fixed Effects	No	Yes	Yes
GDP per capita	No	No	Yes
Clusters	85	85	85
Observations	255	255	255

Note: This table reports the first stage estimates relating summer temperature levels to the share of cholera deaths in the population in 1832, 1849 and 1854. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. All variables are in logarithm. Robust standard errors clustered at the department level are reported in brackets. Robust standard errors clustered at the departement level using the Maximum Likelihood approach of Acemoglu et al. (2020) are reported in curly brackets. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

In line with the historical evidence on the spread of cholera in 19^{th} c. France, where the disease mainly hit northern departments during the summers of 1832, 1849 and 1854, Table 7 shows that the summer temperature instrument has a negative and significant effect on the share of cholera deaths in the population (the complete specifications with the control variables are shown in Table D.1). In all the specifications using robust clustered standard errors at the department level, this negative effect is significant at the 1% level. To ensure the robustness of our results, we also compute the standard errors with the maximum likelihood estimation strategy of Acemoglu et al. (2020) that corrects for measurement error and geographic correlation in rainfall measurement. These standard errors are reported in curly brackets in Table 7 and confirm the significant and negative effect of summer temperature on the share of cholera deaths in the population.

The estimate in Column 1 of Table 7 suggests that a 1% decrease in summer temperature levels increased the share of cholera deaths in the population by 11.8%. Hence, for a department experiencing a decrease in temperature from the 75th percentile of summer temperature (18.10 degrees Celsius) to the 50th percentile (i.e., 17.38 degree Celsius), this 4.03% decrease in temperature would entail 0.6% more in the share of cholera deaths in the population, i.e., a decline equal to one standard deviation. Thus, in line with the historical evidence, these computations suggest that the successive cholera pandemics entailed a substantial loss of population.

3.2.2 Falsification tests and robustness checks for pre-trends

To enhance the credibility of our identification strategy, we present several falsification tests and robustness checks for pre-trends. They show that neither summer temperatures nor cholera deaths are correlated with potentially omitted variables pertaining to the pre-existing characteristics of the departments that could drive their vulnerability to the cholera epidemics and their subsequent adoption of technology.

Note that we already discussed the following robustness checks in Section 2: (i) Tables 2 and 3 show that all population groups (distinguished by age or gender, urban or rural) were equally affected by the cholera; (ii) Tables C.1 and C.2 show that the numbers of victims in the 1832, 1849 and 1854 cholera pandemics were not correlated with the numbers of victims from various causes of death in each department in 1855 or with the numbers of victims in the minor cholera outbreaks in 1884 and 1892 (which occurred after the transmission mode of the disease was understood); (iii) Tables C.3 and C.4 show that the diffusion of cholera pandemics in 1832, 1849 and 1854 is neither correlated with the number of towns hit in each department by the spread of the plague in the 18^{th} c., nor correlated with the spread of viral diseases in 1992, 2009 and 2014, i.e., 160 years later; and (iv) Table 5 shows that there are no significant differences in the prices of imported machinery in agriculture and industry that could potentially drive the results.

In what follows, we summarize the additional falsification tests which we carry out in support of our identification strategy. In the Appendix, we present the data sources and report the regression results.

Cholera, temperatures and rainfall. Because weather data are correlated over time, a potential concern regarding the identification strategy is that the significant effect of summer temperature levels on cholera deaths in the year of each pandemic can be attributed to the general effect of summer temperatures in other years, and is correlated with temperatures in other seasons and with rainfall. Reassuringly, the share of cholera deaths is not correlated with summer temperatures in the years just before or after the cholera outbreaks in Table D.2. Moreover, in the years of cholera outbreaks, the share of cholera deaths in the population is not correlated with temperatures in spring, fall and winter in Table D.3, with summer temperature shocks in Table D.4 and with rainfall in Table D.5.

Pre-pandemic trade and industry. A potential concern regarding the exogeneity of the relationship between summer temperature and cholera deaths pertains to trade and industry. In particular, it is possible that the transport of goods within France, and the associated circulation of people, would be correlated with weather conditions and would have an impact on the spread of the pandemic. Reassuringly, both Tables D.6 and D.7 show that there is no relationship between internal trade and temperature as well as between internal trade and the spread of cholera.

In addition, Table D.8 shows that summer temperature and technology adoption in industry were not correlated before the first cholera pandemic in 1832. Namely, in 1789, 1811 and 1815, summer temperatures had no significant impact on the numbers of iron forges and mechanical mills in the cotton industry. Furthermore, Column (1) of Table D.12 shows that the spread of the cholera was not associated with the trade cost caused by the Napoleonic blockade that shifted the geographic pattern of the French textile industry (Juhász, 2018).

Pre-pandemic characteristics of the population. Table D.9 shows that the first stage relationship is not influenced by omitted variables linking summer temperatures and the number of deaths in each department over time. Furthermore, Tables D.10 and D.11 show that summer temperatures and cholera deaths were not correlated with the number and density of inhabitants as well as with the age structure of each department prior to the 1832, 1849 and 1854 cholera pandemics.

Pre-pandemic human capital & wealth. It could be conjectured that the share of cholera deaths in the population was correlated with the relative presence of poor/rich individuals or of educated/uneducated individuals. While there is no historical evidence suggesting that the cholera victims were characterized by specific social statuses or income levels, Tables D.12-D.15 are meant to assuage concerns regarding a possible link between cholera deaths, education and wealth.

Thus, Columns (2)-(4) of Table D.12 show that the share of cholera deaths in the population was not correlated with the higher tail of human capital in the 18^{th} c. as proxied by the number of subscribers to the Quarto edition of the *Encyclopédie* (Darnton, 1973; Squicciarini and Voigtländer, 2015) or with the changes in the social composition of the population triggered by the French Revolution as measured by the shares of *émigrés* and terror victims in each department (Finley et al., 2021; Franck and Michalopoulos, 2017).

Moreover, in line with the historical evidence, Table D.13 shows that the cholera claimed victims among different occupational groups, whether rich (e.g., shipowners), poor (e.g., tenant farmers) or educated (e.g., clergymen, professors & teachers). Furthermore, Table D.14 shows that there is no significant relationship between the share of cholera deaths in the population, the probability that the dead left an inheritance as well as the value of the inheritance. Finally, Table D.15 shows that the cholera pandemics were not correlated with human capital as proxied by the likelihood that individuals born one to 20 years before each pandemic could sign their wedding license (as opposed to mark it with a cross).

4 Results

This section explores the effect of the cholera pandemics on technology adoption and innovation in agriculture and industry. The regression results in Tables 8-11 suggest that the cholera epidemics had short-term and quantitatively small effects on technology adoption and innovation (Appendix E reports the regression results with the full set of controls). These effects were conducive to technology adoption in agriculture but not in the industrial sector. The results are robust to the inclusion of control variables, including GDP per capita, thereby making it unlikely that they are driven by short-term negative income effects.

In our results, our IV estimates for the effect of the cholera epidemics on technology adoption are two to three times larger than the OLS coefficients. A possible interpretation of these findings is that our regressions suffer from errors in variables and attenuation bias: while there is no evidence that the local civil servants who collected data on the number of cholera deaths sought to minimize or inflate the impact of the epidemics, some might have collected data more diligently than others. Another explanation is that our IV estimates reflect the expectations of individuals regarding the consequences of the cholera epidemics. These expectations, which might be viewed as self-fulfilling, explain the different effects of labor scarcity on technology adoption in agriculture and in industry. Finally, another interpretation is that the OLS estimates, unlike the IV estimates, underestimate the actual impact of the cholera epidemics on technology adoption.

In addition, three series of robustness checks support our main regression results. First, while our main regression results focus on the number of machines and tools per worker, Tables F.1-F.3 show the robustness of their sign and significance when the dependent variables are only the number of machines and tools. Second, we show that our main regression results are robust to accounting for spatial autocorrelation in two ways. In line with Kelly

(2019), we compute the Moran I test and its p-value over the residuals of each regression and are unable to reject the null hypothesis of no spatial autocorrelation at the 1%-level (these statistics are reported with the full specifications in Tables E.4-E.18 and Tables I.1-I.7). We also show in Tables G.1-G.6 that our main regression results are robust to using a weighting matrix based on the great-circle distance between the department's administrative centers (Colella et al., 2020). Third, we show in Tables H.1-H.2 that they are also robust to accounting for heterogeneous treatment effects using the two-way fixed effects estimators of de Chaisemartin and D'Haultfoeuille (2020).

4.1 Technology adoption, wages and production in industry

In the mining industry. The effects of the 1849 and 1854 cholera pandemics on the mining industry suggest that labor and capital are complementary factors of production. The upper part of Table 8 shows that the cholera had a negative and significant effect on the average number and horse power of steam-powered machines per worker inside mines in the year that followed each outbreak. Similarly, the lower part of Table 8 indicates that the cholera had a significant negative impact on the average numbers of steam generators and boilers per worker inside mines one year after each outbreak.

However the negative and significant effects of labor scarcity on technology adoption are quantitatively small. The IV regression results in Table 8 suggest that a department at the median of the distribution of the share of cholera deaths in the population (0.057%) would have had 3.68 fewer steam-powered machines (0.11 of the sample mean), 5.22 fewer horse power in steam-powered machines (0.01 of the sample mean), 4.23 fewer steam generators per worker (0.10 of the sample mean) and 5.66 fewer boilers per worker (0.19 of the sample mean). Furthermore, additional regressions available upon request show that these negative and significant effects of cholera on technology adoption in the mining sector do not persist in subsequent years. These limited quantitative effects may explain why we find no significant effect on wages and the number of workers in the year after each outbreak in the upper part of Table 9.

Moreover, the lower part of Table 9 shows that the cholera had no effect on the production of coal but led the mining industry to reduce the production of peat over the next three years. This is most likely because peat is cheaper than coal as the combustion of the former produces less energy than that of the latter. In other words, the complementarity of production factors led producers to make a rational decision and reduce the production of

Table 8: The Effects of the Cholera in 1849 & 1854 on the Number and Horse Power of Machines per Worker in the Mining Industry One Year after each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Steam-Powered Machines per Worker Year t+1					Average Horse Power of Steam-Powered Machines per Worker Year t+1				
Share of Cholera Deaths in Population	-24.33***	-30.79***	-28.51***	-75.52**	-64.49**	-32.98**	-37.52**	-34.61**	-104.7**	-91.55**
	[8.538]	[9.632]	[8.720]	[31.71]	[28.28]	[13.66]	[15.18]	[14.38]	[46.60]	[43.80]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes	No	No	Yes	No	Yes
Within R2	0.174	0.228	0.255			0.123	0.137	0.155		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Average Number of Steam-Powered Machines per Worker Year t+1					Average Horse Power of Steam-Powered Machines per Worker Year t+1				
Summer Temperature				13.60**	11.53**				18.86**	16.37**
				[5.977]	[5.357]				[8.808]	[8.172]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Steam Generators per Worker Year t+1					Average Number of Boilers per Worker Year t+1				
Share of Cholera Deaths in Population	-21.29**	-27.51***	-24.89***	-86.21**	-74.20**	-13.64	-20.14*	-20.51*	-90.47**	-99.37**
	[8.887]	[10.31]	[9.427]	[34.05]	[30.86]	[10.50]	[10.35]	[10.36]	[38.90]	[41.65]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes	No	No	Yes	No	Yes
Within R2	0.131	0.182	0.215			0.211	0.329	0.330		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Average Number of Steam Generators per Worker Year t+1					Average Number of Boilers per Worker Year t+1				
Summer Temperature				15.53**	13.26**				16.30**	17.76**
				[6.325]	[5.718]				[7.479]	[7.237]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number and horse power of steam-powered machines per worker as well as to the number of boilers and steam generators per worker in the mining sector in the year after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table 9: The Effects of the Cholera in 1849 & 1854 on Employment, Wages and Production in the Wake of Each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Workers Year t+1					Average Wage per Worker Year t+1				
Share of Cholera Deaths in Population	3.960	9.768	8.128	38.65	30.41	-24.46	-11.48	-12.78	99.52	101.0
	[7.685]	[9.736]	[8.917]	[33.55]	[31.01]	[22.63]	[22.71]	[22.23]	[93.35]	[92.91]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Geographic Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
GDP per capita	No	No	Yes	No	Yes	No	Yes	No	Yes	No
Within R2	0.064	0.326	0.341			0.009	0.130	0.131		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Average Number of Workers Year t+1					Average Wage per Worker Year t+1				
Summer Temperature				-6.961	-5.436				-17.93	-18.06
				[6.389]	[5.804]				[16.01]	[15.70]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Value of Extracted Coal (t+2)-(t+3)					Average Value of Extracted Peat (t+2)-(t+3)				
Share of Cholera Deaths in Population	-2.765	-2.409	3.615	-2.625	2.732	-9.316**	-11.37**	-10.98**	-25.95**	-24.71*
	[2.242]	[1.832]	[6.429]	[1.867]	[6.724]	[4.672]	[5.090]	[5.254]	[12.06]	[13.79]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	Yes	No	No	No	Yes	No	Yes
Within R2	0.091	0.157	0.162			0.367	0.464	0.467		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature			-0.180***		-0.179***				-0.180***	-0.179***
			[0.0471]		[0.0485]				[0.0471]	[0.0485]
1st stage F-stat			14.602		13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Average Value of Extracted Coal (t+2)-(t+3)					Average Value of Extracted Peat (t+2)-(t+3)				
Summer Temperature			-0.651		-0.488				4.675**	4.417
			[1.157]		[1.213]				[2.330]	[2.660]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number and wage of workers in the mining sector in the year after each cholera outbreak and to the values of extracted coal and peat two and three years after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

the least valuable good.

In the textile industry. Tables E.8 and E.9 report the effects of the 1832 and 1854 cholera pandemics on the textile industry in 1839-47 and 1860-65 at the arrondissement level. As we noted above, these data cannot be used in a panel data framework, thereby leading us to run Equations (1) and (2) without fixed effects.

In line with the results in Tables 8 and 9, Tables E.8 and E.9 show that the pandemics had a negative and significant but quantitatively limited on the number and horse-power of water-, wind- and steam-powered machines in the textile industry. For instance, the OLS regression in Column (5) in Table E.9 shows that an area at the median distribution of the share of cholera deaths (0.057%) would have 1.84% fewer horse power of steam engines in 1860-65. In addition, in Table E.9, the 1854 cholera epidemic is shown to have a negative and significant effect on the total number of workers in the 2SLS regression in Column (8) as well as a negative impact on the wages of male, female and child workers in the OLS regressions in Columns (9), (11) and (13). These effects are however quantitatively small: in an area experiencing the median share of cholera deaths in the population (0.057%), the wages of men, women and children would only decline by 0.24%, 0.27% and 0.55% respectively.

Overall, the negative effects of labor scarcity on technology adoption in the mining and textile industries were short-lived and quantitatively limited.[15] In other words, our analysis suggests that areas that were hit the harshest by the cholera epidemics only momentarily stopped replacing old machines with new ones. This result thus contrasts with that of Abramitzky et al. (forthcoming) on the effects of the 1920 U.S. quotas where the negative effect of labor scarcity on technology adoption in mining persisted over time. Before venturing a mechanism, we examine the effect of labor scarcity on technology adoption, wages and production in agriculture.

4.2 Technology adoption, wages and production in agriculture

The effects of the 1849 and 1854 cholera pandemics on the agricultural sector in 1852 and 1862 suggest that labor and capital are substitute factors of production. Columns (1)-(5) in the upper part of Table 10 show that the share of cholera deaths in the population had a significant and positive but quantitatively limited impact on the number of mechanized

[15] Additional results confirm that the cholera pandemics did not have any long-term effects: they show that the share of cholera deaths did not have any impact on the shares of the industrial workforce and of professionals (e.g., doctors, lawyers, etc...) 40 years after each cholera outbreak while Table E.7 shows that it did not have an effect on GDP per capita 150 years afterwards.

Table 10: The Effects of the Cholera in 1849 & 1854 on the Number of Mechanized Ploughs and Animal-Powered Threshing Machines per Day Laborer and on the Number and Wage of Agricultural Day Laborers in 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Mechanized Ploughs per Day Laborer					Animal-Powered Threshing Machines per Day Laborer				
Share of Cholera Deaths in Population	67.29**	55.09*	58.35*	323.6***	369.9***	18.90*	18.32**	18.58**	2.708	3.002
	[28.36]	[29.67]	[29.65]	[117.4]	[135.1]	[9.529]	[8.501]	[8.516]	[7.922]	[7.940]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes	No	No	Yes	No	Yes
Within R2	0.615	0.672	0.674			0.354	0.488	0.49		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Mechanized Ploughs per Day Laborer					Animal-Powered Threshing Machines per Day Laborer				
Summer Temperature				-58.29***	-66.12***				-0.488	-0.537
				[16.49]	[18.28]				[1.531]	[1.549]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Number of Day Laborers					Average Wage of Day Laborers				
Share of Cholera Deaths in Population	-15.56***	-12.39**	-11.32**	-43.19***	-38.86***	0.0072	0.0051	0.0039	0.0353**	0.0304*
	[5.449]	[5.467]	[5.452]	[14.68]	[14.63]	[0.005]	[0.006]	[0.006]	[0.018]	[0.018]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes	No	No	Yes	No	Yes
Within R2	0.924	0.934	0.936			0.464	0.576	0.593		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Number of Day Laborers					Average Wage of Day Laborers				
Summer Temperature				7.780***	6.947***				-0.00637**	-0.00543*
				[2.428]	[2.596]				[0.00315]	[0.00324]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of mechanized ploughs and animal-powered threshing machines per day laborer. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

ploughs per day laborer. The IV estimate in Column (5) in the upper part of Table 10 suggests that departments at the 50th percentile of the distribution of the share of cholera deaths in the population (0.057%) would have experienced an increase of 0.21 in the number of mechanized ploughs per day laborer (0.075 of the sample mean). In addition, Columns (6)-(10) in the upper part of Table 10 show that the cholera epidemics had a positive effect on animal-powered threshing machines per day laborer, even though that result is only significant in the OLS regressions while Table E.12 shows that they had no significant effect on the adoption of steam-powered threshing machines, which were then the most technology advanced agricultural tools available to French farmers.

The pandemics also had a significant but quantitatively limited effect on employment and wages in agriculture. Columns (1)-(5) in the lower part of Table 10 indicate that the cholera had a significant and negative impact on the number of agricultural day laborers (Table E.10 shows the full regressions) while Columns (6)-(10) in the lower part of Table 10 show the positive effect of labor scarcity on wages, although that effect is only significant in the IV regressions. Namely, Column (10) in the lower part of Table 10 suggests that agricultural day laborers in a department experiencing a median loss in population (0.057%) would benefit from a 0.17% wage increase. As such, these results are in line with those of Clemens et al. (2018) and San (forthcoming) that the adoption of labor-saving technologies offset the anticipated increase in wages.

Furthermore, Tables E.13, E.14, and E.15, show that the effects of the cholera on land rents were limited. Labor scarcity had a slightly positive and significant effect on the rents of meadows of "first and second class"(i.e., highest and medium quality), but no such impact on the rents of meadows of "third class"(i.e., lowest quality) as well as no significant effect on the rents of arable land and vineyards, irrespective of quality.

Finally, Tables E.16 and E.17 show that the cholera pandemics had a slightly negative and significant effect on the production of wheat and rye but none on the production of millet, oats and corn. This negative impact of labor scarcity on wheat and rye may reflect lower demand for these crops or may suggest that the investments for a capital-intensive crop like wheat were not sufficient to prevent a decline in production.[16] In addition, it might have been conjectured that the cholera pandemics would have driven out less efficient farmers but the results suggest that the pandemics and their associated toll on economic activity did not cause any major change in land concentration that could have directly increased mechanization in agriculture.

[16] Wheat is a capital-intensive crop, unlike labor-intensive crops like corn and hay (Lafortune et al., 2015).

Overall, our results establish that labor scarcity had a positive, limited and significant effect on the adoption of agricultural tools in the short-run, suggesting that production factors in agriculture are complementary. The adopted tools were not however the most advanced ones, which were steam-powered, but rather mechanized ploughs and animal-powered threshing machines. The most straightforward explanation is that acquiring steam-powered engines was not profitable enough for most farmers, all the more so as coal was scarcer in France than in England and Germany (Cameron and Neal, 2015). However, faced with labor scarcity and higher wages, it can be hypothesized that French landowners would try to cut production costs, notably by looking for more efficient irrigation tools and fostering innovation in agricultural hydraulic technologies. This is what we explore in the next section.

4.3 Innovation

Table 11: The Effects of Cholera in 1832, 1849 & 1854 on the Number of Patents and the Share of Agricultural Hydraulic Patents in the Ten Years following each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Total Number of Patents					Share of Agricultural Hydraulic Patents				
	Year t+1 to t+10									
Share of Cholera Deaths in Population	2.307	0.500	1.525	27.69*	29.69*	0.127	-0.0260	-0.00630	4.047**	4.106**
	[9.408]	[9.496]	[8.919]	[15.52]	[15.47]	[0.413]	[0.433]	[0.425]	[1.728]	[1.783]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	No	No	Yes	No	No	No	No	Yes
Within R2	0.692	0.708	0.718			0.003	0.031	0.032		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	255	255	255	255	255	255	255	255	255	255
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.141***	-0.140***				-0.141***	-0.140***
				[0.0303]	[0.0308]				[0.0303]	[0.0308]
1st stage F-stat				21.652	20.788				21.652	20.788
	Reduced Form: the dependent variable is									
	Total Number of Patents					Share of Agricultural Hydraulic Patents				
	Year t+1 to t+10									
Summer Temperature				-3.900	-4.165*				-0.570***	-0.576***
				[2.364]	[2.257]				[0.209]	[0.211]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of patents and the share of agricultural hydraulic patents in the decade after each outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

In this section, Table 11 assesses the impact of the cholera pandemics in 1832, 1849 and 1854 on innovation in the ten years after each pandemic. Columns 1-5 in Table 11 show that the cholera pandemics entailed a rise in the total number of patents in the following ten years. However, this positive effect is only significant in the IV regressions at the 10% level. Furthermore, Columns 6-10 in Table 11 indicate that the general increase in the number of patents was spearheaded by the rise in agricultural hydraulic patents but that this effect was only significant in the IV regressions. The IV estimate in Column 10 of Table 11 suggests that departments at the median of the distribution of the share of cholera deaths in the population (0.057%) would have experienced a significant, albeit limited, increase of 0.44% in the share of agricultural hydraulic patents.

Overall, in line with our analysis above regarding technology adoption in agriculture, we find that labor scarcity was conducive to innovation in agricultural irrigation, although its impact was quantitatively limited. Additional results available upon request show that the cholera had no systematically significant effect on the shares of other patent categories, and in particular on patents in the industrial sector.

5 Mechanism: human capital

In this section, we offer a mechanism to explain our main results: we argue that labor scarcity provided incentives to invest in literacy as it increased the expected returns to human capital. Because of the complementarity between education and technology (Katz and Margo, 2014; Atack et al., 2019; Franck and Galor, 2022), this increase in literate workers canceled out the negative effect of population losses on technology adoption in industry. In addition, labor scarcity made menial jobs in agriculture less appealing to literate workers, thereby leading to more technology adoption and innovation in agriculture to cut production costs as cheap labor was harder to find. If this conjecture is correct, areas hit by the cholera epidemics would have experienced increases in (i) literacy and in (ii) child and adult education as well as in public spending on education.

5.1 Literacy

Table 12 captures the relationship between the cholera pandemics and literacy at the individual level: it focuses on the ability of brides and grooms born in each department between one to 20 years after each cholera outbreak to sign their wedding license, as opposed to mark it with a cross (Table I.1 displays the regression results with the full set of controls). The regression results suggest that the cholera pandemics had a positive and significant effect at the 1% level on the literacy of brides and grooms. The IV estimate in Column 6 of Table 12 suggests that individuals in departments at the median (0.057%) of the distribution of the share of cholera deaths in the population would have experienced an increase of 1.60% in their ability to sign a wedding license one to 20 years later (relative to sample mean of 80%).

Table 12: The Effects of the Cholera in 1832, 1849 & 1854 on the Signatures of Wedding Licenses by Spouses Born One to 20 Years after Each Cholera Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	2SLS	2SLS	2SLS
Signature of Wedding License For Individuals Born 1 to 20 Years after Each Epidemic						
Share of Cholera Deaths in Population	6.739***	5.969***	5.538***	27.87***	25.65***	28.09***
	[1.324]	[1.377]	[1.683]	[4.936]	[5.942]	[6.721]
Male	-0.009	-0.009	-0.009	-0.009	-0.009	-0.009
	[[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	No	Yes	Yes
Geographic Controls	No	Yes	Yes	No	Yes	Yes
GDP per capita	No	No	Yes	No	No	Yes
R^2	0.190	0.194	0.194	0.179	0.185	0.185
Clusters	3085	3085	3085	3085	3085	3085
Observations	11,953	11,953	11,953	11,953	11,953	11,953
First stage: the instrumented variable is Share of Cholera Deaths in Population						
Summer Temperature				-0.0826***	-0.0709***	-0.0629***
				[0.006]	[0.006]	[0.005]
1st stage F-stat				208.6	168.1	185.9
Reduced Form: the dependent variable is Signature of Wedding License For Individuals Born Years t+1 - t+20 after Each Epidemic						
Summer Temperature				-2.301***	-1.819***	-1.767***
				[0.400]	[0.414]	[0.416]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the ability of brides and grooms born one to 20 years after each outbreak to sign their wedding license. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the year-department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

The positive and significant but quantitatively limited effects of labor scarcity on literacy are confirmed by Table I.2 that focuses on the departmental share of literate army conscripts (i.e., 20-year old men who could read and write) born during the year of each pandemic, as well as 20 and 35 years later. The IV estimates in Columns 5 and 10 of Table I.2 show that departments at the median (0.057%) of the distribution of the share of cholera deaths in the population would have experienced a quantitatively small but significant increase in their share of literate conscripts by 0.86% 20 years later (relative to sample mean of 77%) and by 0.66% 40 years later (relative to a sample mean of 88%). Furthermore, Columns

11-15 of Table I.2 show that the cholera did not have a significant impact on the literacy of conscripts born 35 years after each outbreak. This lack of significance can be explained by the fact that those army conscripts were born in 1867, 1884 and 1899, i.e., two of these three cohorts were born after the adoption of the 1881-1882 laws on free and mandatory schooling until age 13 for boys and girls. These policies thus offset the long-term positive effect of the cholera pandemics on literacy.

Overall, in line with our main analysis, the results in this section suggest that labor scarcity had a positive and significant effect on literacy. This effect was persistent but quantitatively small. As such, it was probably sufficient to compensate for the negative effect of the population loss on technology adoption, but not sufficiently large for the increase in literacy and skilled workers to give an edge in technology adoption and innovation to areas heavily hit by the cholera epidemics.

5.2 Child & adult education and public spending on education

While the previous section establishes the positive effect of the epidemics on literacy, it raises the question as to whether labor scarcity immediately gave adults incentives to invest in their human capital but also gave parents incentives to invest in their children's human capital, notably through higher school attendance rates and greater public spending.

Table I.3 assesses the effect of the cholera on the number of participants in courses for male adults and apprentices in 1837, 1850 and 1863 and female apprentices in 1850 and 1863 while Table I.4 analyzes the effect of the pandemics on the number of available courses for men and women as well as public spending on courses for men (data on spending for courses for women are not available). They show that the pandemics increased the number of participants in courses for male adults and apprentices as well as public spending on these courses. However, labor scarcity neither had a significant effect on the number of courses for female adults and apprentices nor on the number of participants in these courses. A potential explanation for this result is that agricultural mechanization mainly reduced the demand for male labor, thereby leading men to invest more in human capital and seek work in industry where literacy skills were necessary (e.g. Franck and Galor, 2022).

Table I.5 shows that the impact of the cholera pandemics in 1832, 1849 and 1854 on the primary school attendance rate of boys and girls out of the population age 5-15 in 1837, 1851 and 1856 is positive but not significant in all the specifications. Moreover, Tables I.6 and I.7 assess the effect of the cholera on public spending on primary schooling by the three tiers of the French government, i.e., the central state, the departments and the communes. Because of data limitations, they only focus on the impact of the 1854 cholera pandemic. Whether we consider total education spending or education spending per inhabitant, the results suggest that the pandemic had a negative impact on the departments' spending but none on that of the communes and of the central state, and overall, no effect on total public spending on primary schooling.

As such, in line with our analysis that views labor and technology as complementary factors of production in industry and substitute in agriculture, labor scarcity entailed a rise in human capital in the aftermath of the cholera pandemics. This increase did not stem from the rising importance of state-funded primary schooling. Instead it resulted from private investments made by parents in their own human capital as well as that of their children.

5.3 Alternative explanations

Other than the increase in human capital, factors such as migration, urbanization, fertility, age at marriage, religiosity or local financial intermediation, could provide alternative explanations for our main results. In this section, we briefly present the tests which we carry out to assess the importance of such factors and provide more detailed explanations, including the data sources, in the Appendix. Reassuringly, our tests show that these factors were not correlated with the spread of cholera or with summer temperatures in 1832, 1849 and 1854.

Migration and urbanization. 19^{th} c. France was characterized by a high rate of internal migration (Daudin et al., 2019) but no historical evidence connects migration and urbanization to the cholera epidemics. If anything, the potential effects of labor scarcity on migration and urbanization are not straightforward. Labor scarcity entails higher wages and may attract immigrants but the adoption of new technology may lower wages and hence trigger emigration (e.g., Fadinger and Mayr, 2014). It may also be the case that individuals would leave areas hit by the cholera to escape death and would not come back. Tables J.1 and J.2 show that migration and urbanization were not correlated with the spread of cholera and cannot therefore drive our main results (it nonetheless bears pointing out that both Tables do not rule that migration and urbanization could have played a role in technology adoption and innovation).

Religiosity. To account for research highlighting the link between natural disasters (such as pandemics) and religiosity (e.g., Bentzen, 2019), we explore whether the cholera outbreaks could be correlated with changes in religiosity and potentially with a deeper cultural shift that could delay or accelerate technology adoption and innovation. Table J.3 shows that the pandemics had a positive and significant but quantitatively small effect on the share of seminarians in the population, and no significant impact on the share of religious community members in the population. Overall, these results suggest that religiosity was not affected by the cholera pandemics and cannot therefore explain their impact on technology adoption.

Fertility and nuptiality. Mortality shocks triggered by pandemics could have an impact on optimal fertility behavior (Boucekkine et al., 2009; Siuda and Sunde, 2021). However, given that the fertility decline in France had begun in the late 18^{th} c. (e.g., Galor, 2011), it is not clear whether the spread of cholera could have an impact on fertility rates and on the age at marriage. Tables J.4 and J.5 show that indeed, the cholera epidemics had no systematic significant effect on fertility and nuptiality patterns, thereby suggesting that those channels did not affect our results.

Local financial intermediation. Because of the relationship between financial intermediation, economic growth and innovation(e.g., Gorodnichenko and Schnitzer, 2013; Gennaioli et al., 2014), we examine whether labor scarcity fostered technological adoption through the presence of local banks. Table J.6 reports the impact of the cholera pandemics on the amount of deposits per capita in the savings banks of each department averaged over the five year period which followed each pandemic. The effect is insignificant in all the specifications. These results thus suggest that local financial development was not correlated with the cholera outbreaks and cannot therefore drive our results pertaining to technology adoption and innovation.

6 Conclusion

This paper examines the impact of labor scarcity entailed by the cholera epidemics in 1832, 1849 and 1854 in France on subsequent technology adoption and innovation. The results show that in the short-run, labor scarcity had a positive and significant impact on technology adoption and innovation in agriculture while it had a negative impact on technology adoption in industry. As labor scarcity increased the expected returns to human capital, individuals invested more in their own literacy: this increase in the share of literate individuals in the population canceled out the negative effect of the population loss on technology adoption. Moreover, menial agricultural work became less appealing to literate workers, thereby leading to more technology adoption and innovation in agriculture.

There are three main implications of this study. First, it suggests that in the 19^{th}

century, labor and technology were substitute factors of production in agriculture but complementary in industry. Second, it provides some support for the notion that agricultural mechanization in 19^{th} c. France was partly fostered by labor scarcity. Third, it provides a moderate view on the effects of repeated pandemics on economic growth. Notwithstanding the human losses, the economic consequences of pandemics in societies that escaped the Malthusian trap appear quantitatively limited in the short-run and disappear in the mid- to long-run.

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Appendix

Labor Scarcity, Technology Adoption and Innovation: Evidence from the Cholera Pandemics in 19^{th} century France

A Descriptive statistics

Table A.1: Descriptive statistics: department-, arrondissement and individual-level variables

	Obs	Mean	Std.dev	Min	Max
Measures of technological progress and human capital at the department level					
Number of Mechanized Ploughs per Day Laborer	170	2.80	3.17	0.20	18.65
Average Daily Wage per Day Laborer	170	1.81	1.10	0.32	4.59
Number of Animal-Powered Threshing Machines per Day Laborer	170	0.096	0.268	0.000	2.010
Number of Steam-Powered Threshing Machines per Day Laborer	170	0.002	0.004	0.000	0.034
Workers	170	117.48	373.04	0	2767
Average Wage	170	66.54	5231.63	0.05	6164.848
Boilers per Workers	170	29.50	133.43	1	1465
Steam Generator per Worker	170	42.19	115.45	1	1001
Number of Steam-Powered Machines per Worker	170	34.74	105.86	1	952
Horse Power of Steam-Powered Machines per Worker	170	359.11	983.24	1	6726
Average Value of Extracted Coal (t+2)-(t+3)	170	0.53	0.65	0	2.20
Average Value of Extracted Peat	170	0.23	0.66	0	6.52
Share of Literate Conscripts 20 Years after Cholera (Born the Year of the Cholera)	246	0.77	0.15	0.31	0.994
Share of Literate Conscripts 40 Years after Cholera (Born 20 Years After Cholera)	246	0.88	0.11	0.50	0.996
Share of Literate Conscripts 55 Years after Cholera (Born 35 Years After Cholera)	246	0.95	0.06	0.64	0.999
Share of Agricultural Hydraulic Patents - Year t+1 to t+10	255	0.051	0.054	0	0.33
Total Patents - Year t+1 to t+10	255	232.15	1129.01	0	15834
Number of Participants in Courses for Male Adults and Apprentices	255	873.30	1366.80	0	12650
Number of Participants in Courses for Female Adults and Apprentices	170	97.19	302.68	0	2367
Measures of technological progress at the arrondissement level					
Number of Water-Powered Engines Per Worker – Textile 1839-47	355	0.002	0.008	0	0.083
Number of Wind-Powered Engines Per Worker – Textile 1839-47	355	0.00003	0.0003	0	0.005
Number of Steam-Powered Engines Per Worker – Textile 1839-47	355	0.0007	0.005	0	0.087
Number of Workers – Textile 1839-47	355	844.58	3626.11	0	40300
Average Wage of Male Workers – Textile 1839-47	181	178.87	54.12	60	435
Average Wage of Female Workers– Textile 1839-47	167	90.12	26.10	30	175
Average Wage of Child Workers – Textile 1839-47	144	55.96	16.19	20	125
Horse Power of Water-Powered Engines Per Worker – Textile 1860-65	357	0.032	0.180	0	2.75
Horse Power of Wind-Powered Engines Per Worker – Textile 1860-65	357	5.58e-06	0.0001	0	0.002
Horse Power of Steam-Powered Engines Per Worker – Textile 1860-65	357	.008	.034	0	0.275
Number of Workers – Textile 1860-65	357	577.79	3855.95	0	55739
Average Wage of Male Workers – Textile 1860-65	151	217.23	59.18	90	450
Average Wage of Female Workers – Textile 1860-65	122	113.2552	30.8193	48.75	200
Average Wage of Child Workers – Textile 1860-65	83	78.39	19.92	30	122
Individuals Born 1 to 20 Years After each Epidemic					
Age	11953	24.72	4.61	15	58
Male	11953	0.470	0.50	0	1
Signature	11953	0.80	0.40	0	1
Measure of labor scarcity					
Share of Cholera Deaths in Population (department-level)	255	0.003	0.006	0.000	0.042
Share of Cholera Deaths in Population 1832 (arrondissement-level)	357	0.003	0.006	0	0.041
Share of Cholera Deaths in Population 1854 (arrondissement-level)	357	0.004	0.009	0	0.067
Characteristics of departments					
GDP per capita	255	0.40	0.20	0.16	1.76
Deviation from Summer Rainfall in Year (t) (Baseline Years (t-1)-(t-25))	255	-0.11	0.84	-1.99	1.48
Land suitability	255	0.75	0.18	0.21	0.98
Share of carboniferous area in department	255	0.10	0.15	0.00	0.71
Border department	255	0.20	0.40	0	1
Maritime Department	255	0.26	0.44	0	1
Instrumental variable					
Summer Temperature	255	17.44	1.34	13.32	21.77

Table A.2: Descriptive statistics: variables for falsification tests

	Obs	Mean	Std. Dev.	Min	Max
Spring, Fall and Winter Temperature					
Spring Temperature	255	9.44	1.57	1.00	12.50
Fall Temperature	255	10.41	1.82	0.00	14.24
Winter Temperature	255	3.35	2.00	-1.62	7.85
Summer Temperature Lagged and Forwarded					
Summer Temperature (Year t-1)	255	17.65	1.31	13.69	21.55
Summer Temperature (Year t-2)	255	17.63	1.23	13.79	21.37
Summer Temperature (Year t+1)	255	17.23	1.31	13.08	21.42
Summer Temperature (Year t+2)	255	18.08	1.41	14.03	22.41
Summer, Fall, Winter and Spring Rainfall					
Summer Rainfall	255	224.69	61.65	82.73	420.92
Spring Rainfall	255	171.46	87.30	76.98	630.64
Fall Rainfall	255	119.14	51.21	56.24	361.71
Winter Rainfall	255	150.28	48.65	71.95	337.80
Mortality					
Deaths Excluding Cholera (Year t)	255	10096.69	5255.354	3574	47906
Share of Deaths in Population (Year t-1)	255	0.024	0.004	0.008	0.037
Share of Deaths in Population (Year t-2)	255	0.024	0.004	0.008	0.041
Share of Deaths in Population (Year t-3)	255	0.024	0.003	0.007	0.034
Share of Deaths in Population (Year t-4)	255	0.023	0.004	0.006	0.039
Share of Deaths in Population (Year t+1)	255	0.024	0.005	0.007	0.043
Share of Deaths in Population (Year t+2)	255	0.025	0.004	0.006	0.039
Share of Deaths in Population (Year t+3)	255	0.024	0.004	0.007	0.050
Share of Deaths in Population (Year t+4)	255	0.023	0.004	0.007	0.035
Towns Hit by Pest in 18th Century	85	0.14	0.62	0	4
Incidence Rate, Acute Diarrhea, per 100,000 Inhabitants	36	124.08	35.89	57.3	206.02
Incidence Rate, Influenza, per 100,000 Inhabitants	36	92.37	67.22	22.74	264.08
Incidence Rate, Chicken Pox, per 100,000 Inhabitants	36	21.83	8.54	9.81	48.94
Cholera Deaths in 1884 and 1892					
Cholera Deaths in 1884 and 1892	164	64.39	347.81	1	3911
Causes of Deaths of Men and Women in 1855					
Fever	80	314.88	704.21	12	5966
Cardio-Vascular Illness	80	127.11	278.60	12	2414
Digestive Illness	80	492.45	1152.65	22	9755
Renal Disease	80	9.43	24.04	0	163
Bladder Disease	80	17.05	30.23	0	246
Breast & Chest Disease	80	9.95	22.90	0	197
Skeletal Disease	80	23.92	43.46	1	319
Nervous System Illness	80	59.33	157.993	1	1411
Articular Illness	80	13.94	25.70	0	210
Skin Illness	80	17.06	37.37	0	292
Burn, Cancer & Dropsy	80	73.08	144.49	6	1239
Accidents, Murders & Suicides	80	559.55	1094.15	45	7913
Life Expectancy at Age 15 Before Each Epidemic					
Life Expectancy 5 Years Before Each Epidemic	255	39.79	6.66	23.3	53.3
Life Expectancy 10 Years Before Each Epidemic	255	40.44	7.04	19.4	52.7
Life Expectancy 15 Years Before Each Epidemic	255	39.17	7.26	21	52.4
Life Expectancy 20 Years Before Each Epidemic	255	38.51	6.76	23.1	51.3
Life Expectancy 25 Years Before Each Epidemic	255	39.26	7.38	19.4	52.7
Number of Inhabitants Before Each Epidemic					
Number of Inhabitants 5 Years Before Each Epidemic	255	404303.5	173862.5	129102	1422065
Number of Inhabitants 10 Years Before Each Epidemic	255	382044.2	160179.5	124763	1364467
Number of Inhabitants 20 Years Before Each Epidemic	254	365706.2	145840.4	110732	1106891

Table A.3: Descriptive statistics: variables for robustness checks

	Obs.	Mean	Std.dev	Min	Max
Temperature and Relative Humidity in 2018					
Temperature (C)	121619	13.38	7.60	-16.6	38
Relative Humidity	121619	75.28	17.72	1	100
Internal Trade					
Quantity of Merchandises (Ton) in Warehouses, Year t	255	10.36	52.07	0	548.52
Value of Merchandises (Million French Francs) in Warehouses, Year t	255	5234.70	30353.77	0	263388
Agricultural Production					
Average Value of Wheat Production	170	19.14	3.11	13.43	31.24
Average Value of Millet Production	170	14.86	3.10	0	21.41
Average Value of Oats Production	170	13.33	10.72	9.36	149.92
Average Value of Rye Production	170	7.17	1.74	0.52	12.77
Individuals Born 1 to 20 Years Before each Pandemic					
Signature	9587	0.65	0.48	0	1
Male	9587	0.46	0.50	0	1
Land Rents					
Rent Vineyard 1st class	170	134.54	51.40	49	337
Rent Vineyard 2nd class	170	95.12	37.77	36	234
Rent Vineyard 3rd class	170	63.76	38.95	25	445
Rent Arable Land 1st class	170	83.70	46.22	19	416
Rent Arable Land 2nd class	170	58.08	28.36	12	203
Rent Arable Land 3rd class	170	37.67	21.56	7	171
Rent Vineyard 1st class	170	98.34	61.35	0	285
Rent Vineyard 2nd class	170	69.72	44.25	0	242
Rent Vineyard 3rd class	170	46.79	32.92	0	207
Schooling, Fertility, Religiosity, Migration and Financial Development					
Crude Birth Rate - Year t+1 to t+10	255	0.028	0.005	0.010	0.04
Deposits per Capita - Average t+1-t+5	170	7.75	7.75	1.38	48.21
Stock of Emigrants	243	0.11	0.05	0.002	0.324
Stock of Immigrants	243	0.09	0.07	0.000	0.554
Share of Urban Population	255	0.22	0.13	0.08	0.97
Number of Courses for Male Adults and Apprentices 1837, 1850 & 1863	255	41.21	55.41	0	277
Spending on Courses for Male Adults and Apprentices, 1837, 1850 & 1863	255	6669.51	12438.45	0	135377
Number of Courses for Female Adults and Apprentices 1850 & 1863	170	2.04	4.59	0	27
Primary School Attendance Rate in Year t	255	0.521	0.210	0.126	1
Total Education Spending by Communes Years(t+1)-(t+5)	85	1212444	563261.2	277701	2923468
Total Education Spending by Departments Years(t+1)-(t+5)	85	190829.9	182752.1	0	1120905
Total Education Spending by the Central State Years(t+1)-(t+5)	85	164209.5	212693.3	0	928150
Total Education Spending by Communes Years(t+1)-(t+10)	85	2684896	1180611	636259	6437829
Total Education Spending by Departments Years(t+1)-(t+10)	85	359101.6	320026	0	1873060
Total Education Spending by the Central State Years(t+1)-(t+10)	85	288052.2	392399.5	0	1814290
Share of Seminarians in Population, 1841 1851 & 1856	252	0.0006	0.0005	0	0.002
Share of Religous Community Members in Population, 1841 1851 & 1856	252	0.0009	0.001	0	0.006
Occupations in 1856					
Clergy	87	3280.58	15152.70	385	142705
Naval construction workers	87	716.90	3433.16	0	31185
Professors & Teachers	87	3843.70	17869.14	83	167201
Radiator merchants	87	136.30	634.33	0	5929
Restaurant owners and employees	87	15352.85	70998.27	1481	667849
Tenant farmers	87	57624.44	268016.3	0	2506663
Textile & tissue industry workers	87	43176.85	202901	0	1878193
Transport employees	87	23629.61	109545	916	1027888
Shipowners	87	149.6552	717.8934	0	6510
Wheelwrights & blacksmiths	87	8139.95	37664.07	287	354088
18th c. and 19th c. Political and Institutional Features					
Encyclopedie Subscriptions	255	82.84	145.78	0	1078
Trade Cost Shock	252	1.21	0.67	0.23	2.73
Share of Terror Victims in Population	252	0.0006	0.002	0	0.010
Share of Emigres in Population	252	0.005	0.006	0.0004	0.046

B Temperature and Relative Humidity in France

In this appendix, we discuss the relationship between temperature and relative humidity following the presentation of Wallace and Hobbs (1977) and Lutgens and Tarbuck (2015). We then report regression results on the negative and significant relationship between temperatures and relative humidity in France.

Relative humidity is defined as the ratio of the air's actual water-vapor content compared with the amount of water vapor required for saturation at that temperature, where saturation is "the equilibrium state where the rate of evaporation of molecules from the water will be equal to their rate of condensation on the water from the moist air"(Wallace and Hobbs, 1977, p.72). It is usually expressed as a relationship between air temperature and the dew point temperature which is the temperature where air is cool enough at constant pressure for water to condense on a plane surface. It follows that, for a given level of pressure p, the relationship between relative humidity RH, air temperature T and dew point temperature TD can be approximated with[17]

$$RH \approx 100 - 5(T - TD)$$

As discussed by Lutgens and Tarbuck (2015), relative humidity can change in two ways. First, if the amount of water vapor increases, relative humidity will increase until saturation occurs, i.e., there is 100% relative humidity. Second, cooler air temperatures will increase relative humidity when the water-vapor content of air remains constant (intuitively, water vapor evaporates less at cooler than at higher temperatures).

France experiences different levels of temperature and humidity throughout its territory. Usually, the North is colder than the South. Moreover, northern and western coastal regions on the North Sea and the Atlantic Ocean are usually humid because their climate is influenced by cold sea breezes. However the Mediterranean coast is dryer because of a warm sea and the influence of land breezes. Areas that are removed from the coast are slightly drier, although there are variations because of the nature of the soil, the presence of mountains as well as exposure to wind and sun.

In Table B.1, we report regression results between temperature and relative humidity using intra-day data from the French Meteorology Agency for 42 weather stations collected every day and every three hours throughout 2018. Accounting for time-invariant character-

[17] Relative humidity can be formally defined using the saturation mixing ratio of dew point and air temperature for a given pressure p. See Eq. (2.67) in Wallace and Hobbs (1977, pp. 71-76).

Table B.1: Temperature and Relative Humidity in 2018 in France

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
	Relative Humidity												
	Whole Year	January	February	March	April	May	June	July	August	September	October	November	December
Temperature (C)	-1.513***	-1.511***	-0.421***	-2.486***	-2.994***	-3.063***	-2.677***	-3.392***	-2.880***	-2.690***	-2.721***	-1.794***	-1.397***
	[0.0466]	[0.192]	[0.118]	[0.165]	[0.0833]	[0.0960]	[0.0979]	[0.0929]	[0.0887]	[0.107]	[0.136]	[0.136]	[0.163]
Weather Station Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hour Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	No	No	No	No	No	No	No	No	No	No	No	No
R2	0.533	0.544	0.560	0.551	0.748	0.738	0.814	0.833	0.786	0.757	0.653	0.553	0.552
Clusters	42	42	42	42	42	42	42	42	42	42	42	42	42
Observations	121,619	10,376	9,385	10,270	10,048	10,396	10,038	10,195	10,349	10,019	10,274	10,001	10,268

Note: This table present regression results that use modern weather data from 42 weather stations in 2018 in France to establish that lower temperatures are associated with higher relative humidity, accounting for weather station fixed effects as well as month-, day- and hour- fixed effects. Constant not reported. Standard errors clustered at the weather-station level. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

istics with weather-station fixed effects, as well as with month-, day- and hour-fixed effects, Table B.1 shows that colder temperatures are negatively and significantly associated at the 1%-level with relatively humidity. In other words, Table B.1 shows that northern areas of France are colder and relatively more humid than southern areas, thereby vindicating the negative (and significant) relationship which we find between summer temperatures and the spread of cholera in Table 7.

C Cholera Pandemics in 1832, 1849 & 1854 and Other Pandemics

Table C.1: Cholera Pandemics in the 19^{th} c. after 1855

	(1) OLS	(2) OLS	(3) 2SLS	(4) 2SLS
	Cholera Deaths in 1884 & 1892			
Share of Cholera Deaths in Population 1832 & 1849	50.17*		-400.8	
	[29.77]		[434.3]	
Share of Cholera Deaths in Population 1849 & 1854		-13.38		-7,432
		[16.38]		[63,651]
Adjusted R2	0.007	-0.004		
Clusters	82	82	82	82
Observations	164	164	164	164

Note: This table reports OLS and 2SLS regression results showing that there is no statistically significant relationship between the share of cholera deaths in 1832, 1849 and 1854 and the share of cholera deaths in 1884 and 1892. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table C.2: Cholera Pandemics in 1832, 1849 & 1854 and Causes of Deaths of Men and Women in 1855

	(1) OLS Fever	(2) OLS Cardio-Vascular Illness	(3) OLS Digestive Illness	(4) OLS Renal Disease	(5) OLS Bladder Disease	(6) OLS Breast & Chest Disease	(7) OLS Skeletal Disease	(8) OLS Articular Illness	(9) OLS Skin Illness	(10) OLS Burn, Cancer & Dropsy	(11) OLS Accidents, Murders & Suicides
Share of Cholera Deaths in Population, 1832	-12.21	-3.844	-9.620	-10.47	-23.68	-2.338	-26.05	-24.29	-15.13	-5.028	-6.722
	[19.14]	[16.79]	[15.84]	[24.33]	[18.34]	[17.25]	[24.39]	[24.21]	[16.59]	[19.77]	[20.29]
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.408	0.471	0.510	0.257	0.359	0.379	0.352	0.173	0.387	0.407	0.350
Observations	80	80	80	80	80	80	80	80	80	80	80
	(12) OLS Fever	(13) OLS Cardio-Vascular Illness	(14) OLS Digestive Illness	(15) OLS Renal Disease	(16) OLS Bladder Disease	(17) OLS Breast & Chest Disease	(18) OLS Skeletal Disease	(19) OLS Articular Illness	(20) OLS Skin Illness	(21) OLS Burn, Cancer & Dropsy	(22) OLS Accidents, Murders & Suicides
Share of Cholera Deaths in Population, 1849	39.99	32.52	16.99	30.35	16.36	11.28	-1.465	8.583	22.85	14.60	32.48
	[32.88]	[25.81]	[27.15]	[36.21]	[27.77]	[24.42]	[24.79]	[34.24]	[27.36]	[22.55]	[31.85]
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.429	0.483	0.494	0.252	0.326	0.403	0.404	0.186	0.384	0.438	0.340
Observations	80	80	80	80	80	80	80	80	80	80	80
	(23) OLS Fever	(24) OLS Cardio-Vascular Illness	(25) OLS Digestive Illness	(26) OLS Renal Disease	(27) OLS Bladder Disease	(28) OLS Breast & Chest Disease	(29) OLS Skeletal Disease	(30) OLS Articular Illness	(31) OLS Skin Illness	(32) OLS Burn, Cancer & Dropsy	(33) OLS Accidents, Murders & Suicides
Share of Cholera Deaths in Population, 1854	2.438	-7.048	2.211	11.46	7.196	-11.72	-7.817	11.35	-4.174	-6.579	-6.963
	[9.619]	[6.253]	[8.861]	[11.26]	[13.48]	[11.48]	[10.44]	[16.02]	[11.24]	[6.352]	[10.29]
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.416	0.484	0.527	0.302	0.386	0.383	0.367	0.247	0.446	0.401	0.393
Observations	80	80	80	80	80	80	80	80	80	80	80

Note: This table reports OLS regression results showing that there is no statistically significant relationship between the share of cholera deaths in 1832, 1849 and 1854 and the causes of deaths of men and women in 1855. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm.

Table C.3: Cholera Pandemics in 1832, 1849 & 1854 and Pest in 18^{th} c. France

	(1)	(2)	(3)
	OLS	OLS	OLS
	Towns Hit by Pest in 18th Century		
Share of Cholera Deaths in Population 1832	-6.955		
	[4.253]		
Share of Cholera Deaths in Population 1849		-5.457	
		[7.946]	
Share of Cholera Deaths in Population 1854			6.447
			[4.451]
Geographic Controls	Yes	Yes	Yes
Adjusted R2	-0.004	-0.014	0.010
Observations	85	85	85

Note: This table reports OLS regression results showing that there is no statistically significant relationship between the share of cholera deaths in 1832, 1849 and 1854 and the number of towns in each department hit by the pest in 18^{th} c. France. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

Table C.4: Cholera Pandemics in 1832, 1849 & 1854 and Viral Diseases in 1992, 2009 & 2014

	(1)	(2)	(3)
	OLS	OLS	OLS
	Incidence Rate Acute Diarrhea	Incidence Rate Influenza	Incidence Rate Chicken Pox
	per 100,000 inhabitants		
Share of Cholera Deaths in Population	-1.778	-1.726	0.759
	[1.540]	[2.961]	[1.670]
Department Fixed Effects	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes
Clusters	12	12	12
Observations	36	36	36
Within R2	0.675	0.760	0.469

Note: This table reports OLS regression results showing that there is no statistically significant relationship between the share of cholera deaths in 1832, 1849 and 1854 and the spread of viral diseases in 1922, 2009 & 2014. Data and robust standard errors clustered at the regional level. Constant not reported. All variables are in logarithm. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

D First Stage Regressions and Robustness Checks

D.1 Summer Temperature Levels and Share of Cholera Deaths in the Population in 1832, 1849 & 1854: First Stage Estimates

Table D.1: Summer Temperature Levels and Share of Cholera Deaths in the Population in 1832, 1849& 1854 and : First Stage Estimates

	(1)	(2)	(3)
First stage: the instrumented variable is Share of Cholera Deaths in Population			
Summer Temperature	-0.118***	-0.141***	-0.140***
	[0.0271]	[0.0303]	[0.0308]
Deviation from Summer Rainfall in Year (t)		-0.0007	-0.0007
(Baseline Years (t-1)-(t-25))		[0.0007]	[0.0007]
Land Suitability * Year Dummies		0.0002**	0.0002**
		[9.23e-05]	[9.04e-05]
Border Department * Year Dummies		0.0002**	0.0002**
		[8.98e-05]	[8.88e-05]
Maritime Department * Year Dummies		0.00001	0.00001
		[5.04e-05]	[4.81e-05]
Share of Carboniferous Area * Dummies		-0.0001	-0.00004
		[0.0001]	[0.0001]
GDP per capita			-0.0023
			[0.005]
1st stage F-stat	19.012	21.652	20.788
Moran I	-0.008	-0.008	-0.008
Moran I p-value	0.212	0.209	0.210
Department and Year Fixed Effects	Yes	Yes	Yes
Clusters	85	85	85
Observations	255	255	255

Note: This table reports the first stage estimates relating summer temperature levels to the share of cholera deaths in the population in 1832, 1849 and 1854. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

D.2 Falsification tests and robustness checks for first stage regression results

In this section, we discuss our falsification tests and robustness checks. They enhance the credibility of our identification strategy as they show that neither summer temperatures nor cholera deaths are correlated with potentially omitted variables pertaining to the pre-pandemic characteristics of the departments that could drive the adoption of technology.

Note that we already discussed the following robustness checks in Section 2: (i) Tables 2 and 3 show that all population groups (distinguished by age or gender, urban or rural) were equally affected by the cholera; (ii) Tables C.1 and C.2 show that the numbers of victims in the 1832, 1849 and 1854 cholera pandemics were not correlated with the number of victims from various causes of death in each department in 1855 or with the number of victims in the minor pandemics in 1884 and 1892 (which occurred after the transmission mode of the disease was understood); (iii) Tables C.3 and C.4 show that the diffusion of cholera pandemics in 1832, 1849 and 1854 is neither correlated with the number of towns hit in each department by the spread of the plague in the 18^{th} c., nor correlated with the spread of viral diseases in 1992, 2009 and 2014, i.e., 160 years later; and (iv) Table 5 shows that there are no significant differences in the prices of machinery in agriculture and industry which could potentially drive the results.

In what follows, we show that summer temperature levels in the years of the pandemics are the relevant instrument for cholera deaths because (v) cholera deaths are not correlated with summer temperatures in the years just before or after the cholera outbreaks (Table D.2). Moreover, in the years of cholera outbreaks, the share of cholera deaths in the population is not correlated with (vi) temperatures in spring, fall and winter (Table D.3), (vii) with summer temperature shocks (Table D.4) or (viii) with rainfall (Table D.5). Finally, we show that our results cannot be explained by the pre-pandemic economic characteristics of the departments, i.e., (ix) industry and trade (Tables D.6-D.8), or by the pre-pandemic characteristics of the population, i.e., (x) the mortality rate (Table D.9), the population number and density (Table D.10), the age structure of the population (Table D.11), as well as with (xi) human capital and wealth (Tables D.13-D.15).

D.2.1 Cholera, temperatures and rainfall

Because weather data are correlated over time, a potential concern regarding the instrumentation strategy is that the significant effect of summer temperature on cholera deaths in the year of each pandemic can be attributed to the general effect of summer temperatures in other years, and is correlated with temperatures in other seasons and with rainfall. Tables D.2-D.5 are meant to assuage those concerns.

Table D.2: Falsification Test: Cholera in 1832, 1849 & 1854 and Summer Temperatures in Other Years

	(1)	(2)	(3)
	2SLS	2SLS	2SLS
First stage: the instrumented variable is Share of Cholera Deaths in Population			
Summer Temperature (Year t of Cholera Epidemic)	-0.140***	-0.169***	-0.141***
	[0.0308]	[0.0296]	[0.0357]
Summer Temperature (Year t-1)		0.0656	
		[0.0402]	
Summer Temperature (Year t+1)		-0.0886	
		[0.108]	
Summer Temperature (Year t-2)			-0.0255
			[0.0269]
Summer Temperature (Year t+2)			-0.0333
			[0.0459]
1st stage F-stat	20.788	14.536	9.778
Moran I	-0.008	-0.008	-0.008
Moran I p-value	0.210	0.209	0.208
Reduced Form: the dependent variable is Share of Agricultural Hydraulic Patents - Year t+1 to t+5			
Summer Temperature (Year t of Cholera Epidemic)	-1.063***	-1.079***	-0.709**
	[0.318]	[0.380]	[0.311]
Summer Temperature (Year t-1)		0.0379	
		[0.423]	
Summer Temperature (Year t+1)		-0.0652	
		[0.785]	
Summer Temperature (Year t-2)			0.0868
			[0.383]
Summer Temperature (Year t+2)			1.282***
			[0.470]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes
Department and Year Fixed Effects	Yes	Yes	Yes
Clusters	85	85	85
Observations	255	255	255

Note: This table reports first stage estimates and reduced form regressions (using the Share of Agricultural Hydraulic Patents) showing that there is a statistically significant relationship between summer temperatures in 1832, 1849 and 1854 and the share of cholera deaths in 1832, 1849 and 1854, but not between the latter and summer temperatures in other years before or after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

In Table D.2, where we build upon the specification in Column 3 of Table 7, we find in both first-stage and reduced form regressions that the instrument Summer Temperature

Table D.3: Falsification Test: Cholera in 1832, 1849 & 1854, Summer Temperatures and Temperatures in Other Seasons

	(1)	(2)	(3)	(4)
First stage: the instrumented variable is Share of Cholera Deaths in Population				
Summer Temperature	-0.140***	-0.134***	-0.119***	-0.136***
	[0.0308]	[0.0416]	[0.0271]	[0.0320]
Spring Temperature		-0.0088		
		[0.0214]		
Fall Temperature			-0.0106***	
			[0.0031]	
Winter Temperature				0.0008
				[0.0040]
1st stage F-stat	20.788	18.671	18.276	10.875
Moran I	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.210	0.210	0.206	0.211
Reduced Form: the dependent variable is Share of Agricultural Hydraulic Patents - Year t+1 to t+5				
Summer Temperature	-1.063***	-0.983**	-1.118***	-0.742**
	[0.318]	[0.408]	[0.367]	[0.286]
Spring Temperature		-0.108		
		[0.318]		
Fall Temperature			0.0280	
			[0.0422]	
Winter Temperature				0.0656**
				[0.0301]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes
Department and Year Fixed Effects	Yes	Yes	Yes	Yes
Clusters	85	85	85	85
Observations	255	255	255	255

Note: This table reports first stage estimates and reduced form regressions (using the Share of Agricultural Hydraulic Patents) showing that there is a statistically significant relationship between summer temperatures in 1832, 1849 and 1854 and the share of cholera deaths in 1832, 1849 and 1854, but not between the latter and temperatures in other seasons in those years. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithms. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

during cholera pandemics (i.e., in year t) keeps its significant and negative sign when we include Summer Temperatures in the two years before or after year t (for the sake of the argument, we use the Share of Agricultural Hydraulic Patents as the dependent variable in the reduced form regressions.) Furthermore, in both first-stage and reduced form regressions, the instrument Summer Temperature in year t retains its sign and significance when temperatures in spring, fall and winter in year t are included in Table D.3; when deviations from standardized temperatures in spring, summer, fall and winter in year t are included in Table D.4; and when rainfalls in spring, summer, fall and winter in year t are included in Table D.5.

Table D.4: Falsification Test: Cholera in 1832, 1849 & 1854, and Temperature Shocks

	(1)	(2)	(3)	(4)
First stage: the instrumented variable is Share of Cholera Deaths in Population				
Summer Temperature	-0.146**	-0.0997***	-0.0976***	-0.0803***
	[0.0697]	[0.0208]	[0.0189]	[0.0180]
Deviation from Summer Temperature in Year (t)	0.003			
(Baseline Years (t-1)-(t-25))	[0.003]			
Deviation from Spring Temperature in Year (t)		-0.0007		
(Baseline Years (t-1)-(t-25))		[0.0007]		
Deviation from Autumn Temperature in Year (t)			-0.001*	
(Baseline Years (t-1)-(t-25))			[0.0008]	
Deviation from Winter Temperature in Year (t)				-0.0006
(Baseline Years (t-1)-(t-25))				[0.0004]
1st stage F-stat	10.806	11.950	14.475	10.881
Moran I	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.209	0.210	0.210	0.209
Geographic Controls * Year Fixed Effects	No	No	No	No
GDP per capita	No	No	No	No
Department- and Year- Fixed Effects	No	No	No	No
Clusters	85	85	85	85
Observations	255	255	255	255

Note: This table reports first stage estimates showing that there is a statistically significant relationship between summer temperatures and the share of cholera deaths in 1832, 1849 and 1854 when accounting for summer temperature shocks, i.e., abnormal deviations from summer temperatures. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table D.5: Falsification Test: Cholera in 1832, 1849 & 1854 and Rainfall

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature	-0.0887***		-0.0838***		-0.108***		-0.116***		-0.103***	-0.124***
	[0.021]		[0.016]		[0.025]		[0.027]		[0.025]	[0.025]
Summer Rainfall		0.009**	0.002							-0.002
		[0.004]	[0.003]							[0.004]
Spring Rainfall				-0.002	-0.006***					-0.004*
				[0.002]	[0.002]					[0.002]
Fall Rainfall						0.0003	-0.004***			-0.001
						[0.0007]	[0.001]			[0.002]
Winter Rainfall								0.003	0.006***	0.004
								[0.002]	[0.002]	[0.004]
1st stage F-stat	18.494	5.017	13.135	1.724	9.337	0.132	9.152	1.744	8.838	5.445
Moran I	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.210	0.210	0.205	0.209	0.204	0.210	0.202	0.201	0.208	0.204 9
Reduced Form: the dependent variable is Share of Agricultural Hydraulic Patents - Year t+1 to t+5										
Summer Temperature	-0.536**		-0.630**		-0.622***		-0.713***		-0.564**	-0.875***
	[0.218]		[0.255]		[0.216]		[0.242]		[0.219]	[0.289]
Summer Rainfall		0.024	-0.032							-0.043
		[0.029]	[0.032]							[0.037]
Spring Rainfall				-0.0058	-0.029					-0.017
				[0.026]	[0.025]					[0.031]
Fall Rainfall						0.0002	-0.028			-0.0289
						[0.017]	[0.018]			[0.021]
Winter Rainfall								-0.006	0.012	-0.009
								[0.021]	[0.020]	[0.030]
Geographic Controls * Year Fixed Effects	No	No	No	No	No	No	No	No	No	No
GDP per capita	No	No	No	No	No	No	No	No	No	No
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	255	255	255	255	255	255	255	255	255	255

Note: This table reports first stage estimates and reduced form regressions (using the Share of Agricultural Hydraulic Patents) showing that there is a statistically significant relationship between summer temperatures in 1832, 1849 and 1854 and the share of cholera deaths in 1832, 1849 and 1854, but not between the latter and rainfall in those years. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

D.2.2 Summer Temperatures, Cholera, Industry and Trade

A potential concern regarding the exogeneity of the relationship between summer temperature and cholera deaths pertains to trade. It is possible that the transport of goods within France, and the associated circulation of people, would be correlated with weather conditions and would have an impact on the spread of the pandemic. To test for this conjecture, we collect data on the quantity and the value (in million French Francs) of merchandises in warehouses as provided by the successive volumes of the French government's trade statistics (*Tableau décennal du commerce de la France*). Table D.6 shows there is no significant correlation between Summer Temperature and the quantity and value of merchandises in the year before, during or after each pandemic. Moreover, Table D.7 shows there is no significant relationship between the quantity and value of merchandises in the year before, during or after each pandemic and the share of cholera deaths in the population. As such, both Tables indicate that there is no relationship between internal trade and temperature as well as between internal trade and the spread of cholera.

Table D.6: Falsification Test: Summer Temperature in 1832, 1849 & 1854 and Quantity (in Ton) and Value (in Million French Francs) of Merchandises in Warehouses

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
	Quantity of Merchandises			Value of Merchandises		
	Year t	Year t+1	Year t-1	Year t	Year t+1	Year t-1
Summer Temperature (Year t)	8.631	4.989	4.200	10.96	7.999	6.079
	[10.98]	[10.78]	[10.64]	[9.541]	[9.199]	[8.886]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.414	0.448	0.434	0.559	0.598	0.597
Moran I -0.009	-0.009	-0.009	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.163	0.171	0.151	0.202	0.195	0.191
Clusters	85	85	85	85	85	85
Observations	255	255	255	255	255	255

Note: This table reports OLS regressions showing that there is no significant relationship between summer temperatures in 1832, 1849 and 1854 and the quantity or value of merchandises in warehouses across the French territory. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table D.7: Falsification Test: Cholera Deaths in Population in 1832, 1849 & 1854 and Quantity (in Ton) and Value (in Million French Francs) of Merchandises in Warehouses

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
	Share of Cholera Deaths in Population					
Quantity of Merchandises (ton) in Warehouses, Year t	-0.0002					
	[0.0002]					
Quantity of Merchandises (ton) in Warehouses, Year t+1		-0.0001				
		[0.0002]				
Quantity of Merchandises (ton) in Warehouses, Year t-1			-8.21e-06			
			[0.0002]			
Value of Merchandises (millions French Francs) in Warehouses, Year t				-0.0003		
				[0.0002]		
Value of Merchandises (millions French Francs) in Warehouses, Year t+1					-0.0002	
					[0.0003]	
Value of Merchandises (millions French Francs) in Warehouses, Year t-1						-0.0001
						[0.0003]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.100	0.098	0.097	0.106	0.100	0.098
Moran I	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.219	0.218	0.218	0.218	0.218	0.218
Clusters	85	85	85	85	85	85
Observations	255	255	255	255	255	255

Note: This table reports OLS regressions showing that there is no significant relationship between the share of cholera deaths in 1832, 1849 and 1854 and the quantity or value of merchandises in warehouses across the French territory. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01, ^{**} p < 0.05, ^{*} p < 0.1$.

Table D.8: Summer Temperatures & Technology Adoption in 1789, 1811 & 1815

	(1) OLS	(2) OLS	(3) OLS	(4) OLS
	Forges		Mechanical Mills	
	1789	1811	1789	1815
Summer Temperature 1789	-0.0107		0.141	
	[0.837]		[0.188]	
Summer Temperature 1811		0.295		
		[0.712]		
Summer Temperature 1815				-1.166
				[0.959]
Deviation from Summer Rainfall	No	No	No	No
Geographic Controls * Year Fixed Effects	No	No	No	No
GDP per capita	No	No	No	No
Department and Year Fixed Effects	No	No	No	No
Adjusted R2	-0.012	-0.011	-0.010	0.005
Observations	85	85	85	85

Note: This table reports OLS regressions showing that there is no significant relationship between the share of cholera deaths in 1832, 1849 and 1854 and the presence of iron forges in 1789, 1811 and 1815 in each department. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithms.$^{***}p < 0.01, ^{**} p < 0.05, ^{*} p < 0.1$.

In addition, Table D.8 shows that summer temperature and technology adoption were not correlated before the first cholera pandemic in 1832. Namely, in 1789, 1811 and 1815, summer temperatures have no impact on the numbers of iron forges and mechanical mills in the cotton industry in those years.

Finally, Column (1) of Table D.12 shows that the spread of the cholera was not associated with the trade cost caused by the Napoleonic blockade that shifted the geographic pattern of the French textile industry (Juhász, 2018).

D.2.3 Summer temperatures, cholera and pre-pandemic characteristics of the population

Table D.9 shows that the first stage relationship in Table 7 is not influenced by omitted variables linking summer temperatures and the number of deaths in each department over time. While Column 1 of Table D.9 reports a first stage regression where Summer Temperature in year t is not significantly correlated with the number of deaths in Year t that were not caused by cholera, Columns 2 to 9 of Table D.9 report first stage regressions where Summer Temperature in year t is not significantly correlated with the Share of Deaths in the Population in the four years before and after each cholera pandemic.

Table D.9: Falsification Test: Summer Temperatures in 1832, 1849 & 1854 and Mortality Statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	First Stage: the dependent variable is								
	Deaths Excluding	Share of Deaths in Population							
	Cholera Year t	Year t-4	Year t-3	Year t-2	Year t-1	Year t+1	Year t+2	Year t+3	Year t+4
Summer Temperature	-0.892	-0.280	-0.413	-0.0140	0.914	0.973	-0.397	-0.183	-0.165
	[0.558]	[0.606]	[0.595]	[0.554]	[0.593]	[0.643]	[0.629]	[0.655]	[0.632]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
1st stage F-stat	2.558	0.214	0.482	0.001	2.373	2.287	0.398	0.078	0.069
Moran I	-0.008	-0.006	-0.007	-0.007	-0.007	-0.007	-0.006	-0.007	-0.006
Moran I p-value	0.240	0.320	0.267	0.294	0.293	0.259	0.305	0.293	0.313
Clusters	85	85	85	85	85	85	85	85	85
Observations	255	255	255	255	255	255	255	255	255

Note: This table reports OLS regressions showing that there is no significant correlation between summer temperatures in 1832, 1849 and 1854 and the share of deaths not attributed to the cholera in each department, as well as the share of deaths in the department population in the years before or after each cholera outbreak. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

Furthermore, using the data on the French population from the successive volumes of the *Statistique Générale de la France* and those on life expectancy computed by Bonneuil (1997), Tables D.10 and D.11 show that summer temperatures and cholera deaths were not correlated with the number and density of inhabitants as well as with the age structure of each department prior to the 1832, 1849 and 1854 cholera pandemics.

Table D.10: Pre-Pandemic Characteristics of Departments: Number of Inhabitants

	(1)	(2)	(3)	(4)	(5)	(6)
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Number of Inhabitants			Density of Inhabitants		
	25 Years	10 Years	5 Years	25 Years	10 Years	5 Years
	Before Each Epidemic					
Share of Cholera Deaths in Population	-0.601	-0.776	-2.294	-0.601	-0.776	-2.294
	[2.388]	[2.452]	[1.439]	[2.388]	[2.452]	[1.439]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Moran I	-0.007	-0.007	-0.007	-0.007	-0.007	-0.007
Moran I p-value	0.266	0.274	0.257	0.266	0.274	0.257
Clusters	85	85	85	85	85	85
Observations	254	255	255	254	255	255
First stage: the instrumented variable is Share of Cholera Deaths in Population						
Summer Temperature	-0.143***	-0.140***	-0.140***	-0.143***	-0.140***	-0.140***
	[0.0314]	[0.0308]	[0.0308]	[0.0314]	[0.0308]	[0.0308]
1st stage F-stat	20.621	20.788	20.788	20.621	20.788	20.788
	Reduced Form: the dependent variable is					
	Number of Inhabitants			Density of Inhabitants		
	25 Years	10 Years	5 Years	25 Years	10 Years	5 Years
	Before Each Epidemic					
Summer Temperature	0.0856	0.109	0.322	0.0856	0.109	0.322
	[0.347]	[0.352]	[0.199]	[0.347]	[0.352]	[0.199]

Note: This table reports OLS regressions showing that there is no significant correlation between the share of cholera deaths in 1832, 1849 and 1854 and the number of inhabitants in each department prior to each cholera outbreak. The Tarn-et-Garonne department was only established in 1808 and is therefore missing from the regression in Column 1. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. $^{***}p < 0.01, ^{**} p < 0.05, ^{*} p < 0.1$.

Table D.11: Pre-Pandemic Characteristics of Departments: Life Expectancy at Age 15

	(1)	(2)	(3)	(4)	(5)
	2SLS	2SLS	2SLS	2SLS	2SLS
	Life Expectancy				
	25 Years	20 Years	15 Years	10 Years	5 Years
	Before Each Epidemic				
Share of Cholera Deaths in Population	-2.569	-2.295	-2.268	-0.994	-1.952
	[2.141]	[2.222]	[2.330]	[1.995]	[2.204]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Moran I	-0.008	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.232	0.232	0.232	0.232	0.232
Clusters	85	85	85	85	85
Observations	255	255	255	255	255
First stage: the instrumented variable is Share of Cholera Deaths in Population					
Summer Temperature	-0.140***	-0.140***	-0.140***	-0.140***	-0.140***
	[0.0308]	[0.0308]	[0.0308]	[0.0308]	[0.0308]
1st stage F-stat	20.788	20.788	20.788	20.788	20.788
	Reduced Form: the dependent variable is Life Expectancy				
	25 Years	20 Years	15 Years	10 Years	5 Years
	Before Each Epidemic				
Summer Temperature	0.360	0.322	0.318	0.139	0.274
	[0.323]	[0.313]	[0.324]	[0.292]	[0.299]

Note: This table reports OLS regressions showing that there is no significant correlation between the share of cholera deaths in 1832, 1849 and 1854 and life expectancy at age 15 in each department in each outbreak. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**} p < 0.05, ^{*} p < 0.1$.

D.2.4 Summer temperatures, cholera, human capital and wealth

Tables D.12, D.13, D.14 and D.15 examine whether the share of cholera deaths in the population could be explained by the sex ratio, the relative age distribution, the relative presence (or absence) of poor/rich individuals, or of educated/uneducated individuals. While there is no historical evidence suggesting that the cholera victims were characterized by specific social statuses or income levels, Tables D.12, D.13, D.14 and D.15 are meant to assuage concerns regarding a possible correlation between cholera deaths, education, wealth and the probability that a technology is patented and/or adopted after the pandemics.

Table D.12: Pre-Pandemic Characteristics of Departments: 18^{th} c. and Early 19^{th} c. Political and Institutional Features

	(1) OLS Trade Cost Shock	(2) OLS Encyclopedie Subscriptions	(3) OLS Share of Terror Victims in Population	(4) OLS Share of Emigres in Population
Share of Cholera Deaths in Population	1.963	2.536	0.00603	-0.0464
	[6.791]	[23.89]	[0.0193]	[0.0690]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	Yes	Yes	Yes	Yes
Geographic Controls	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes
Clusters	85	85	85	85
Adjusted R2	0.211	0.051	0.051	0.157
Observations	255	252	252	252

Note: This table reports OLS regressions showing that the share of cholera deaths in the population is not correlated with pre-pandemic political and institutional features of the departments. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

Columns (2)-(4) of Table D.12 show that the share of cholera deaths in the population was not correlated with the higher tail of human capital in the 18^{th} c. as proxied by the number of subscribers to the Quarto edition of the *Encyclopédie* (Darnton, 1973; Squicciarini and Voigtländer, 2015) or with the changes in the social composition of the population triggered by the French Revolution as measured by the shares of *émigrés* and terror victims in each department (Finley et al., 2021; Franck and Michalopoulos, 2017).

Table D.13 examines the effect of the share of cholera deaths in the population in 1854 on various occupational groups listed in the 1856 French census. In line with the historical evidence, Table D.13 shows that the cholera claimed victims among different occupational groups, whether rich (e.g., shipowners), poor (e.g., tenant farmers) or educated (e.g., clergymen, professors & teachers).[18]

Table D.13: Cholera in 1854 & Number of Members from Selected Occupational Groups in 1856

	(1) OLS Tenant farmers	(2) OLS Textile industry workers	(3) OLS Naval construction workers	(4) OLS Wheelwrights & blacksmiths	(5) OLS Transport employees
Summer Temperature	-8.520***	-12.21***	-8.755**	-2.314*	-2.148*
	[2.102]	[3.038]	[3.993]	[1.351]	[1.230]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.281	0.171	0.347	0.425	0.525
Observations	85	85	85	85	85
	(6) OLS Radiator merchants	(7) OLS Restaurant owners & employees	(8) OLS Shipowners	(9) OLS Professors & Teachers	(10) OLS Clergy
Summer Temperature	-5.362*	-3.695**	-8.313**	-2.698**	-2.630***
	[2.848]	[1.458]	[3.790]	[1.277]	[0.767]
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.067	0.197	0.671	0.222	0.268
Observations	85	85	85	85	85

Note: This table reports OLS regressions showing that individuals who died from cholera were not from specific occupational groups characterized by either low or high education and wealth. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. Geographic and economic variables are included. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table D.14: Cholera in 1832, 1849 & 1854: Individual Level Analysis on Age, Gender, Occupation and Inheritance

	(1) OLS Age	(2) OLS Woman	(3) OLS Agriculture	(4) OLS Industry	(5) OLS Services	(6) OLS Inheritance	(7) OLS Inheritance Value
Summer Temperature	1.460	-0.197	1.817	-1.932	0.114	0.490	-65,271
	[3.840]	[0.999]	[1.500]	[1.416]	[1.533]	[0.919]	[70,766]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Age	No	Yes	Yes	Yes	Yes	Yes	Yes
Gender	Yes	No	Yes	Yes	Yes	Yes	Yes
Occupation	No	No	No	No	No	Yes	Yes
Geographic Controls * Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
GDP per capita	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.033	0.002	0.175	0.046	0.137	0.024	-0.005
Clusters	83	83	82	82	82	82	82
Observations	1,953	1,953	865	865	865	865	865

Note: This table reports OLS regressions showing that individuals in the *Enquête des 3000 familles* (Survey of the 3000 Families) dataset who died in 1832, 1849 & 1854 do not differ on their observable characteristics. There is no data for Meuse and Nièvre, and no data, except for gender and age, for Allier as well. Constant not reported. Robust standard errors clustered at the department level. All variables are in logarithm. Geographic and economic variables are included. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

[18]Regressions available upon request show that not all occupational groups listed in the 1856 survey were hit by the cholera, but the groups which were spared cannot be distinguished by any specific characteristic, e.g., wealth or education.

Furthermore, Table D.14 relates the share of cholera deaths in the population in 1832, 1849 and 1854 to a dummy variable which indicates whether people who died during these three years left an inheritance (Column 1) and to the value of this inheritance (Column 2), controlling for the age, gender and occupation (i.e., with dummies for occupations in agriculture and industry) of the dead. Reassuringly, Table D.14 shows that there is no significant relationship between the share of cholera deaths in the population and these two variables.

Finally, Table D.15 shows that the cholera pandemics were not correlated with human capital as measured by the likelihood that individuals born one to 20 years before each pandemic, could sign their wedding license (as opposed to mark it with a cross).

Table D.15: Falsification test: Cholera in 1832, 1849 & 1854 and Signatures of Wedding Licenses by Spouses Born before 1 to 20 Years before each Cholera Pandemic

	(1)	(2)	(3)
	2SLS	2SLS	2SLS
Signature of Wedding License For Individuals Born One to 20 Years before each Epidemic			
Share of Cholera Deaths in Population	1.445	0.339	0.238
	[2.960]	[2.950]	[2.948]
Male	-0.0140	-0.0141	-0.0141
	[0.00931]	[0.00931]	[0.00931]
Deviation from Summer Rainfall in Year (t)		0.00638	0.00621
(Baseline Years (t-1)-(t-25))		[0.00517]	[0.00517]
Land Suitability * Year Fixed Effects		0.000769	0.000752
		[0.00212]	[0.00213]
Border Department * Year Fixed Effects		-0.00113	-0.00115
		[0.00109]	[0.00109]
Maritime Department * Year Fixed Effects		-0.000798	-0.000806
		[0.000950]	[0.000951]
Share of Carboniferous Area * Year Fixed Effects		0.00218	0.00238
		[0.00402]	[0.00403]
GDP per capita			-0.0299
			[0.0631]
Department- and Year-Fixed Effects	Yes	Yes	Yes
R-squared	0.191	0.192	0.192
Moran I	0.000	0.000	0.000
Moran I p-value	0.250	0.250	0.250
Observations	9,587	9,587	9,587
First stage: the instrumented variable is Share of Cholera Deaths in Population			
Summer Temperature	-0.138***	-0.148***	-0.149***
	[0.00705]	[0.00769]	[0.00772]
1st stage F-stat	385.7	372.4	370.4
Reduced Form: the dependent variable is Signature of Wedding License For Individuals Born One to 20 Years before each Epidemic			
Summer Temperature	-0.200	-0.0503	-0.0353
	[0.412]	[0.440]	[0.441]

Note: This table reports IV regressions showing that there is no significant relationship between the share of cholera deaths in 1832, 1849 & 1854 and the ability of brides and grooms in the *Enquête des 3000 familles* (Survey of the 3000 Families) dataset to sign their wedding license. Constant not reported. Robust standard errors clustered at the year-department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

E. Main Results (with the full set of control variables)

Table E.1: The Effects of the Cholera in 1849 & 1854 on the Number and Horse Power of Steam-Powered Machines per Worker in the Year following each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Steam-Powered Machines per Worker Year t+1					Average Horse Power of Steam-Powered Machines per Worker Year t+1				
Share of Cholera Deaths in Population	-24.33***	-30.79***	-28.51***	-75.52**	-64.49**	-32.98**	-37.52**	-34.61**	-104.7**	-91.55**
	[8.538]	[9.632]	[8.720]	[31.71]	[28.28]	[13.66]	[15.18]	[14.38]	[46.60]	[43.80]
Deviation from Summer Rainfall in Year (t)		-0.0007	-0.0331	0.0532	0.0166		0.0313	-0.0102	0.112	0.0685
(Baseline Years (t-1)-(t-25))		[0.137]	[0.136]	[0.147]	[0.134]		[0.187]	[0.182]	[0.214]	[0.194]
Land Suitability * Year Fixed Effects		0.0265	0.0191	0.0726	0.0572		-0.000563	-0.0101	0.0687	0.0504
		[0.0480]	[0.0501]	[0.0485]	[0.0449]		[0.0655]	[0.0663]	[0.0736]	[0.0664]
Border Department * Year Fixed Effects		0.0549	0.0643	0.106*	0.103*		0.0325	0.0444	0.109	0.105
		[0.0366]	[0.0395]	[0.0635]	[0.0588]		[0.0535]	[0.0557]	[0.0911]	[0.0870]
Maritime Department * Year Fixed Effects		-0.0659	-0.0629	-0.0863	-0.0797		-0.0704	-0.0666	-0.101	-0.0932
		[0.0490]	[0.0463]	[0.0540]	[0.0487]		[0.0740]	[0.0705]	[0.0828]	[0.0748]
Share of Carboniferous Area * Year Fixed Effects		-0.164	-0.201	-0.143	-0.177		-0.0872	-0.135	-0.0565	-0.0967
		[0.119]	[0.121]	[0.125]	[0.121]		[0.218]	[0.227]	[0.222]	[0.229]
GDP per capita			1.119		0.878			1.430		1.049
			[0.741]		[0.652]			[1.167]		[1.126]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.174	0.228	0.255			0.123	0.137	0.155		
Moran I	-0.012	-0.013	-0.013	-0.013	-0.013	-0.012	-0.012	-0.012	-0.012	-0.012
Moran I p-value	0.200	0.183	0.177	0.191	0.183	0.221	0.213	0.210	0.219	0.215
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Average Number of Steam-Powered Machines per Worker Year t+1					Average Horse Power of Steam-Powered Machines per Worker Year t+1				
Summer Temperature				13.60**	11.53**				18.86**	16.37**
				[5.977]	[5.357]				[8.808]	[8.172]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number and horse power of steam-powered machines per worker in the mining sector in the year after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.2: The Effects of the Cholera in 1849 & 1854 on the Number of Boilers and Steam Generators per Worker in the Year following each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Steam Generators per Worker Year t+1					Average Number of Boilers per Worker Year t+1				
Share of Cholera Deaths in Population	-21.29**	-27.51***	-24.89***	-86.21**	-74.20**	-13.64	-20.14*	-20.51*	-90.47**	-99.37**
	[8.887]	[10.31]	[9.427]	[34.05]	[30.86]	[10.50]	[10.35]	[10.36]	[38.90]	[41.65]
Deviation from Summer Rainfall in Year (t)		0.0125	-0.0248	0.0832	0.0434		-0.358**	-0.353**	-0.274	-0.244
(Baseline Years (t-1)-(t-25))		[0.134]	[0.134]	[0.160]	[0.144]		[0.148]	[0.154]	[0.194]	[0.214]
Land Suitability * Year Fixed Effects		-0.00412	-0.0127	0.0564	0.0397		0.0778	0.0790	0.150***	0.163***
		[0.0525]	[0.0530]	[0.0540]	[0.0478]		[0.0579]	[0.0579]	[0.0563]	[0.0565]
Border Department * Year Fixed Effects		0.0621*	0.0728*	0.129*	0.126*		0.0250	0.0235	0.105	0.108
		[0.0371]	[0.0387]	[0.0708]	[0.0648]		[0.0436]	[0.0446]	[0.0882]	[0.0940]
Maritime Department * Year Fixed Effects		-0.0638	-0.0603	-0.0905	-0.0834		-0.0581	-0.0586	-0.0902	-0.0955*
		[0.0507]	[0.0475]	[0.0581]	[0.0518]		[0.0558]	[0.0553]	[0.0585]	[0.0580]
Share of Carboniferous Area * Year Fixed Effects		-0.201	-0.244*	-0.174	-0.211		-0.136	-0.130	-0.104	-0.0768
		[0.136]	[0.139]	[0.141]	[0.137]		[0.131]	[0.131]	[0.124]	[0.126]
GDP per capita			1.286*		0.956			-0.181		-0.709
			[0.769]		[0.693]			[0.736]		[0.933]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.131	0.182	0.215			0.211	0.329	0.330		
Moran I	-0.012	-0.012	-0.012	-0.012	-0.012	-0.012	-0.013	-0.013	-0.013	-0.013
Moran I p-value	0.214	0.202	0.198	0.209	0.203	0.202	0.177	0.178	0.186	0.192
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Average Number of Steam Generators per Worker Year t+1					Average Number of Boilers per Worker Year t+1				
Summer Temperature				15.53**	13.26**				16.30**	17.76**
				[6.325]	[5.718]				[7.479]	[7.237]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of boilers and steam generators per worker in the mining sector in the year after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.3: The Effects of the Cholera in 1849 & 1854 on the Number and Wage of Workers in the Year following each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Workers Year t+1					Average Wage per Worker Year t+1				
Share of Cholera Deaths in Population	3.960	9.768	8.128	38.65	30.41	-24.46	-11.48	-12.78	99.52	101.0
	[7.685]	[9.736]	[8.917]	[33.55]	[31.01]	[22.63]	[22.71]	[22.23]	[93.35]	[92.91]
Deviation from Summer Rainfall in Year (t)		-0.0784	-0.0550	-0.113	-0.0858		0.136	0.155	0.00227	-0.00267
(Baseline Years (t-1)-(t-25))		[0.116]	[0.123]	[0.115]	[0.114]		[0.323]	[0.332]	[0.356]	[0.353]
Land Suitability * Year Fixed Effects		0.229***	0.234***	0.199**	0.211**		-0.250	-0.245	-0.364*	-0.366*
		[0.0777]	[0.0868]	[0.0860]	[0.0924]		[0.182]	[0.175]	[0.202]	[0.197]
Border Department * Year Fixed Effects		-0.134***	-0.140***	-0.167***	-0.164***		-0.308*	-0.313*	-0.434**	-0.435**
		[0.0397]	[0.0410]	[0.0576]	[0.0544]		[0.156]	[0.159]	[0.208]	[0.208]
Maritime Department * Year Fixed Effects		0.0595	0.0573	0.0726	0.0677		-0.143	-0.145	-0.0926	-0.0917
		[0.0522]	[0.0498]	[0.0578]	[0.0530]		[0.108]	[0.108]	[0.125]	[0.126]
Share of Carboniferous Area * Year Fixed Effects		0.460***	0.487***	0.447***	0.472***		-0.591*	-0.570*	-0.642*	-0.647*
		[0.139]	[0.148]	[0.142]	[0.148]		[0.345]	[0.321]	[0.388]	[0.381]
GDP per capita			-0.805		-0.656			-0.643		0.119
			[0.703]		[0.608]			[1.503]		[1.556]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.064	0.326	0.341			0.009	0.130	0.131		
Moran I	-0.013	-0.013	-0.013	-0.013	-0.013	-0.011	-0.011	-0.011	-0.012	-0.012
Moran I p-value	0.181	0.180	0.176	0.183	0.178	0.237	0.233	0.233	0.222	0.223
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Average Number of Workers Year t+1					Average Wage per Worker Year t+1				
Summer Temperature				-6.961	-5.436				-17.93	-18.06
				[6.389]	[5.804]				[16.01]	[15.70]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number and wage of workers in the mining sector in the year after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

Table E.4: The Effects of the Cholera in 1849 & 1854 on the Values of Extracted Coal & Peat Two and Three Years after each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Value of Extracted Coal (t+2)-(t+3)					Average Value of Extracted Peat (t+2)-(t+3)				
Share of Cholera Deaths in Population	-2.765	-2.409	3.615	-2.625	2.732	-9.316**	-11.37**	-10.98**	-25.95**	-24.71*
	[2.242]	[1.832]	[6.429]	[1.867]	[6.724]	[4.672]	[5.090]	[5.254]	[12.06]	[13.79]
Deviation from Summer Rainfall in Year (t)		-0.0461	-0.0533	-0.0430	-0.0504		-0.0849	-0.0905	-0.0674	-0.0715
(Baseline Years (t-1)-(t-25))		[0.0343]	[0.0345]	[0.0336]	[0.0329]		[0.0549]	[0.0558]	[0.0630]	[0.0672]
Land Suitability * Year Fixed Effects		-0.0161	-0.0223	-0.0154	-0.0211		0.0293	0.0280	0.0443*	0.0426
		[0.0159]	[0.0161]	[0.0154]	[0.0151]		[0.0190]	[0.0181]	[0.0242]	[0.0260]
Border Department * Year Fixed Effects		-0.0191	-0.0260	-0.0200	-0.0257		-0.000544	0.00105	0.0161	0.0157
		[0.0136]	[0.0163]	[0.0137]	[0.0158]		[0.0208]	[0.0206]	[0.0282]	[0.0278]
Maritime Department * Year Fixed Effects		-0.0168	-0.0140	-0.0171	-0.0146		-0.0161	-0.0155	-0.0227	-0.0220
		[0.0111]	[0.0118]	[0.0110]	[0.0118]		[0.0181]	[0.0182]	[0.0176]	[0.0181]
Share of Carboniferous Area * Year Fixed Effects		-0.0454	-0.0482	-0.0419	-0.0455		-0.152***	-0.158***	-0.145***	-0.149***
		[0.0345]	[0.0361]	[0.0332]	[0.0345]		[0.0522]	[0.0493]	[0.0522]	[0.0509]
GDP per capita				-0.106	-0.0703			0.191		0.0992
				[0.129]	[0.137]			[0.302]		[0.351]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.091	0.157		0.162		0.367	0.464	0.467		
Moran I	-0.012	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011
Moran I p-value	0.226	0.240	0.241	0.236	0.236	0.263	0.265	0.266	0.264	0.264
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature			-0.180***		-0.179***				-0.180***	-0.179***
			[0.0471]		[0.0485]				[0.0471]	[0.0485]
1st stage F-stat			14.602		13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Average Value of Extracted Coal (t+2)-(t+3)					Average Value of Extracted Peat (t+2)-(t+3)				
Summer Temperature			-0.651		-0.488				4.675**	4.417
			[1.157]		[1.213]				[2.330]	[2.660]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the average values of extracted coal & peat two and three years after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.5: Cholera in 1832, 1849 & 1854: Share of Workforce in Industry 40 Years after the Cholera Epidemics

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) 2SLS	(6) 2SLS	(7) 2SLS
	Share of Workforce in Industry Forty Years after the Cholera						
Share of Cholera Deaths in Population	-15.41	19.00	18.56	18.37*	45.17	32.76	33.41
	[14.79]	[11.42]	[11.18]	[10.94]	[36.08]	[27.81]	[27.99]
Deviation from Summer Rainfall in Year (t)			-0.111	-0.108		-0.118	-0.121
(Baseline Years (t-1)-(t-25))			[0.128]	[0.126]		[0.125]	[0.127]
Land Suitability * Year Fixed Effects			-0.00121	-0.00154		-0.00330	-0.00297
			[0.0183]	[0.0182]		[0.0188]	[0.0189]
Border Department * Year Fixed Effects			0.00597	0.00627		0.00330	0.00286
			[0.00802]	[0.00777]		[0.00852]	[0.00891]
Maritime Department * Year Fixed Effects			0.00909	0.00926		0.00846	0.00824
			[0.00866]	[0.00853]		[0.00874]	[0.00887]
Share of Carboniferous Area * Year Fixed Effects			0.0797*	0.0816*		0.0784*	0.0760
			[0.0470]	[0.0469]		[0.0460]	[0.0462]
GDP per capita			0.240				0.275
			[0.825]				[0.805]
Department and Year Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	-0.001						
Within R2		0.869	0.876	0.875			
Moran I	0.007	-0.007	-0.007	-0.007	-0.007	-0.007	-0.007
Moran I p-value	0.985	0.264	0.263	0.263	0.259	0.263	0.262
Clusters		81	81	81	81	81	81
Observations	243	243	243	243	243	243	243
First stage: the instrumented variable is Share of Cholera Deaths in Population							
Summer Temperature					-0.124***	-0.141***	-0.141***
					[0.0280]	[0.0312]	[0.0315]
1st stage F-stat					19.467	20.537	20.067
Reduced Form: the dependent variable is Share of Workforce in Industry Forty Years after the Cholera							
Summer Temperature					-5.585	-4.634	-4.712
					[4.597]	[4.223]	[4.234]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the share of the workforce in industry 40 years after each outbreak. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.6: Cholera in 1832, 1849 & 1854: Share of Professionals in Workforce 40 Years after the Cholera Epidemics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS
	Share of Professionals in Workforce Forty Years after the Cholera						
Share of Cholera Deaths in Population	6.447	-4.145	-2.643	-2.582	0.598	8.971	9.217
	[5.637]	[4.012]	[3.842]	[3.860]	[13.72]	[11.73]	[11.72]
GDP per capita				0.0766			0.104
				[0.225]			[0.227]
Deviation from Summer Rainfall in Year (t)			-0.0662	-0.0670		-0.0739	-0.0752
(Baseline Years (t-1)-(t-25))			[0.0543]	[0.0540]		[0.0557]	[0.0554]
Land Suitability * Year Fixed Effects			-0.0137	-0.0136		-0.0151	-0.0150
			[0.0199]	[0.0198]		[0.0194]	[0.0193]
Border Department * Year Fixed Effects			-0.00752	-0.00761		-0.00992	-0.0101
			[0.00867]	[0.00869]		[0.00832]	[0.00830]
Maritime Department * Year Fixed Effects			0.00474	0.00468		0.00409	0.00401
			[0.00719]	[0.00715]		[0.00715]	[0.00709]
Share of Carboniferous Area * Year Fixed Effects			-0.0423	-0.0430		-0.0450	-0.0459
			[0.0383]	[0.0388]		[0.0372]	[0.0375]
Department and Year Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.000						
Within R2		0.700	0.715	0.716			
Moran I	-0.002	-0.008	-0.008	-0.008	-0.007	-0.007	-0.007
Moran I p-value	0.641	0.244	0.250	0.250	0.259	0.263	0.262
Clusters		81	81	81	81	81	81
Observations	243	243	243	243	243	243	243
First stage: the instrumented variable is Share of Cholera Deaths in Population							
Summer Temperature					-0.124***	-0.141***	-0.141***
					[0.0280]	[0.0312]	[0.0315]
1st stage F-stat					19.467	20.537	20.067
Reduced Form: the dependent variable is Share of Professionals in Workforce Forty Years after the Cholera							
Summer Temperature					-0.0739	-1.269	-1.300
					[1.714]	[1.703]	[1.695]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the share of professionals in the workforce 40 years after each outbreak. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

Table E.7: Cholera in 1832, 1849 & 1854: GDP per capita in 1982, 1999 & 2004

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS
	Log GDP per Capita (150 Years after the Cholera Epidemics)						
Share of Cholera Deaths in Population	10.49***	0.154	0.475	0.465	4.529	3.415	3.450
	[3.583]	[0.939]	[0.997]	[0.996]	[7.407]	[3.570]	[3.558]
Deviation from Summer Rainfall in Year (t)			0.013	0.013		0.013	0.012
(Baseline Years (t-1)-(t-25))			[0.014]	[0.014]		[0.013]	[0.014
Land Suitability * Year Fixed Effects			0.005	0.005		0.005	0.005
			[0.007]	[0.007]		[0.007]	[0.007]
Border Department * Year Fixed Effects			-0.004	-0.004		-0.004	-0.004
			[0.003]	[0.003]		[0.003]	[0.003]
Maritime Department * Year Fixed Effects			0.00004	0.00005		-0.0001	-0.0001
			[0.002]	[0.002]		[0.002]	[0.002]
Share of Carboniferous Area * Year Fixed Effects			0.009	0.009		0.008	0.008
			[0.0109]	[0.0109]		[0.0104]	[0.0104]
GDP per capita			0.009				0.019
			[0.0633]				[0.0631]
Department and Year Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	0.011						
Within R2		0.947	0.949	0.949			
Moran I	-0.008	-0.006	-0.006	-0.006	-0.006	-0.006	-0.006
Moran I p-value	0.227	0.306	0.312	0.312	0.304	0.311	0.310
Clusters		85	85	85	85	85	85
Observations	255	255	255	255	255	255	255
	First stage: the instrumented variable is Share of Cholera Deaths in Population						
Summer Temperature					-0.118***	-0.141***	-0.140***
					[0.0271]	[0.0303]	[0.0308]
1st stage F-stat					19.012	21.652	20.788
	Reduced Form: the dependent variable is Stock of Emigrants						
Summer Temperature					-0.536	-0.481	-0.484
					[0.888]	[0.522]	[0.518]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in 1832, 1849 and 1854 to GDP per capita in 1982, 1999 & 2004. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table E.8: The Effects of the Cholera in 1832 on the Textile Industry in 1839-47

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS		
	Number of Water-Powered		Number of Wind-Powered		Number of Steam-Powered		Number of		Average Wage in Textile Sector of					
	Engines Per Worker in Textile Sector						Textile Workers		Male Workers		Female Workers		Child Workers	
Share of Cholera Deaths	-0.120*	0.0297	-0.00361*	-0.00366	-0.0458**	-0.213	-56.91	443.8	6.061	-60.21	2.565	-38.63	4.970	-59.11
in Population 1832	[0.0618]	[0.463]	[0.00205]	[0.0213]	[0.0182]	[0.201]	[43.04]	[421.3]	[3.914]	[53.56]	[3.303]	[31.58]	[3.470]	[87.35]
Land Suitability	0.000281	0.000193	1.02e-05	1.02e-05	0.000895	0.000993	0.652	0.358	-0.136	-0.142	-0.178	-0.122	-0.210	-0.175
	[0.00167]	[0.00171]	[2.15e-05]	[2.03e-05]	[0.000743]	[0.000761]	[0.519]	[0.742]	[0.119]	[0.170]	[0.114]	[0.148]	[0.135]	[0.218]
Share of Carboniferous Area	0.00941	0.00916	3.10e-06	3.19e-06	0.00344	0.00371	4.849***	4.034	-0.0917	-0.0418	-0.165	-0.203	-0.460	-0.426
	[0.00713]	[0.00706]	[6.13e-05]	[8.06e-05]	[0.00347]	[0.00352]	[1.539]	[2.573]	[0.243]	[0.336]	[0.269]	[0.289]	[0.323]	[0.461]
Border Department	-0.000910	-0.000824	-5.68e-05	-5.69e-05	-0.000471	-0.000567	0.367	0.653	-0.0697	-0.0927	-0.0918	-0.0866	-0.0416	-0.00553
	[0.00102]	[0.00107]	[4.02e-05]	[3.61e-05]	[0.000349]	[0.000429]	[0.462]	[0.798]	[0.0645]	[0.101]	[0.0601]	[0.0815]	[0.0628]	[0.128]
Maritime Department	-0.00165*	-0.00138	3.98e-05	3.97e-05	1.69e-05	-0.000989*	-0.126	0.791	-0.100*	-0.234	-0.120**	-0.227**	-0.0308	-0.194
	[0.000853]	[0.00141]	[3.90e-05]	[5.31e-05]	[0.000476]	[0.000543]	[0.402]	[1.119]	[0.0544]	[0.154]	[0.0554]	[0.114]	[0.0647]	[0.255]
Deviation from Summer Rainfall in 1832	0.000848	0.000582	5.19e-05	5.20e-05	0.000512	0.000580	0.510*	-0.378	0.0333	0.134	0.00890	0.0761	0.000760	0.105
(Baseline Years (t-1)-(t-25))	[0.000577]	[0.00108]	[4.58e-05]	[4.39e-05]	[0.000372]	[0.000458]	[0.283]	[0.869]	[0.0379]	[0.107]	[0.0425]	[0.0733]	[0.0488]	[0.163]
GDP per capita 1840	0.000593	-0.000314	6.28e-05	6.32e-05	-0.000184	0.000900	1.701**	-1.325	0.334***	0.809**	0.397***	0.652***	0.257***	0.687
	[0.00146]	[0.00306]	[6.17e-05]	[0.000166]	[0.000931]	[0.00132]	[0.676]	[2.454]	[0.0979]	[0.355]	[0.0804]	[0.222]	[0.0818]	[0.607]
Adjusted R2	0.012		0.011		-0.007		0.034		0.240		0.227		0.124	
Observations	355	355	355	355	355	355	355	355	181	181	167	167	144	144
	First Stage: the instrumented stage is Share of Cholera Deaths in Population 1832													
Summer Temperature 1832		-0.00910*		-0.00910*		-0.00910*		-0.00910*		-0.00946		-0.0115*		-0.00570
		[0.00480]		[0.00480]		[0.00480]		[0.00480]		[0.00603]		[0.00687]		[0.00636]
1st stage F-stat		3.590		3.590		3.590		3.590		2.465		2.781		0.805
	Reduced Form: the dependent variable is													
	Number of Water-Powered		Number of Wind-Powered		Number of Steam-Powered		Number of		Average Wage in Textile Sector of					
	Engines Per Worker in Textile Sector						Textile Workers		Male Workers		Female Workers		Child Workers	
Summer Temperature 1832		-0.000270		-0.000469		0.00194		-4.037		0.570*		0.443*		0.337
		[0.00426]		[0.000198]		[0.00178]		[2.666]		[0.331]		[0.262]		[0.289]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each arrondissement in 1832 to the number of machines in the textile industry as well as the number of textile industry workers and their wages (for men, women and children) in 1839-47. Geographic controls include land suitability, share of carboniferous area and dummies for border and maritime arrondissements. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.9: The Effects of the Cholera in 1854 on the Textile Industry in 1860-65

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS		
	Horse Power of Water-		Horse Power of Wind-		Horse Power of Steam-		Number of		Average Wage in Textile Sector of					
	Powered Engines Per Worker in Textile Sector						Textile Workers		Male Workers		Female Workers		Child Workers	
Share of Cholera Deaths in Population 1854	0.0766	-0.912	-0.000574	-0.00416	-0.322***	-1.141	1.412	-157.0*	-4.241***	-8.972	-4.719**	-22.83	-9.699**	4.471
	[0.447]	[3.698]	[0.000553]	[0.00419]	[0.113]	[0.770]	[16.01]	[84.01]	[1.486]	[13.05]	[2.018]	[20.72]	[4.030]	[20.06]
Land Suitability	-0.0375	-0.0318	1.62e-06	2.23e-05	0.00501	0.00973	0.282	1.195*	-0.117	-0.0982	-0.235***	-0.148	-0.156	-0.213
	[0.0382]	[0.0344]	[4.09e-06]	[2.52e-05]	[0.00578]	[0.00727]	[0.469]	[0.613]	[0.101]	[0.117]	[0.0833]	[0.119]	[0.204]	[0.200]
Share of Carboniferous Area	-0.0750	-0.0775	-2.49e-05	-3.40e-05	0.0294	0.0274	1.833	1.431	-0.298	-0.304	-0.256	-0.234	-0.822**	-0.764**
	[0.0695]	[0.0700]	[2.56e-05]	[3.66e-05]	[0.0185]	[0.0186]	[1.284]	[1.378]	[0.259]	[0.250]	[0.240]	[0.250]	[0.336]	[0.377]
Border Department	-0.00690	-0.00289	-4.58e-06	9.99e-06	0.00930**	0.0126**	0.526*	1.169**	0.0139	0.0323	-0.0553	0.0328	-0.0327	-0.0701
	[0.0141]	[0.0209]	[5.15e-06]	[1.49e-05]	[0.00405]	[0.00511]	[0.273]	[0.519]	[0.0668]	[0.0766]	[0.0651]	[0.106]	[0.0805]	[0.0971]
Maritime Department	-0.0111	-0.0118	-3.84e-06	-6.60e-06	0.00546	0.00483	0.363	0.242	-0.0214	-0.0194	-0.0505	-0.0413	-0.0767	-0.0566
	[0.0128]	[0.0126]	[4.96e-06]	[9.11e-06]	[0.00388]	[0.00385]	[0.292]	[0.317]	[0.0573]	[0.0551]	[0.0637]	[0.0625]	[0.0556]	[0.0651]
Deviation from Summer Rainfall in 1854	-0.00304	-0.000269	1.53e-05	2.53e-05	0.00471*	0.00700**	0.0425	0.486	0.0915**	0.0995**	0.103**	0.160*	0.0789*	0.0834*
(Baseline Years (t-1)-(t-25))	[0.0117]	[0.0166]	[1.45e-05]	[2.37e-05]	[0.00248]	[0.00321]	[0.207]	[0.353]	[0.0453]	[0.0491]	[0.0497]	[0.0872]	[0.0425]	[0.0506]
GDP per capita 1860	-0.0337*	-0.0350*	7.23e-06	2.59e-06	0.0117	0.0107	0.253	0.0480	0.433***	0.423***	0.468***	0.387***	0.366***	0.339***
	[0.0201]	[0.0200]	[8.35e-06]	[1.23e-05]	[0.00830]	[0.00864]	[0.405]	[0.604]	[0.0638]	[0.0684]	[0.0692]	[0.123]	[0.0671]	[0.0893]
Adjusted R2	0.004		-0.008		0.019		-0.005		0.319		0.364		0.383	
Observations	357	357	357	357	357	357	357	357	151	151	122	122	83	83
First Stage: the instrumented stage is Share of Cholera Deaths in Population 1854														
Summer Temperature 1854		0.0177***		0.0177***		0.0177***		0.0177***		0.0214***		0.0209*		0.0203**
		[0.00675]		[0.00675]		[0.00675]		[0.00675]		[0.00810]		[0.0106]		[0.00933]
1st stage F-stat		6.885		6.885		6.885		6.885		6.995		3.905		4.744
Reduced Form: the dependent variable is														
	Horse Power of Water-		Horse Power of Wind-		Horse Power of Steam-		Number of		Average Wage in Textile Sector of					
	Powered Engines Per Worker in Textile Sector						Textile Workers		Male Workers		Female Workers		Child Workers	
Summer Temperature 1854		-0.0162		-7.37e-05		-0.0202		-2.782**		-0.192		-0.477		0.0909
		[0.0675]		[7.27e-05]		[0.0140]		[1.348]		[0.269]		[0.407]		[0.406]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each arrondissement in 1854 to the horse power of machines in the textile industry as well as the number of textile industry workers and their wages (for men, women and children) in 1860-65. Geographic controls for include their land suitability, their share of carboniferous area and dummies for arrondissements located in border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.10: The Effects of the Cholera in 1849 & 1854 on the Number and Wage of Agricultural Day Laborers in 1852 & 1862

	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) 2SLS	(6) OLS	(7) OLS	(8) OLS	(9) 2SLS	(10) 2SLS
	Number of Day Laborers					Average Wage of Day Laborers				
Share of Cholera Deaths in Population	-15.56***	-12.39**	-11.32**	-43.19***	-38.86***	0.0072	0.0051	0.0039	0.0353**	0.0304*
	[5.449]	[5.467]	[5.452]	[14.68]	[14.63]	[0.005]	[0.006]	[0.006]	[0.018]	[0.018]
Deviation from Summer Rainfall in Year (t)		0.125**	0.110*	0.162*	0.148*		0.00003	0.00005	0.0000001	0.00001
(Baseline Years (t-1)-(t-25))		[0.0626]	[0.0653]	[0.0844]	[0.0784]		[7.71e-05]	[8.32e-05]	[8.35e-05]	[8.09e-05]
Land Suitability * Year Fixed Effects		-0.004	-0.008	0.027	0.021		-0.00010	-0.00009	-0.00013	-0.00012
		[0.0676]	[0.0643]	[0.0688]	[0.0645]		[7.17e-05]	[6.58e-05]	[8.15e-05]	[7.71e-05]
Border Department * Year Fixed Effects		-0.035	-0.030	0.0004	-0.001		0.00003	0.00003	-0.000002	-0.000001
		[0.0341]	[0.0331]	[0.0444]	[0.0412]		[3.78e-05]	[3.70e-05]	[4.26e-05]	[4.03e-05]
Maritime Department * Year Fixed Effects		0.022	0.023	0.007	0.010		-4.63e-05***	-4.79e-05***	-3.25e-05*	-3.55e-05*
		[0.0205]	[0.0196]	[0.0239]	[0.0240]		[1.47e-05]	[1.42e-05]	[1.95e-05]	[1.97e-05]
Share of Carboniferous Area * Year Fixed Effects		0.057	0.039	0.071	0.058		-0.0002*	-0.0002*	-0.0002*	-0.0002*
		[0.114]	[0.109]	[0.116]	[0.111]		[0.0001]	[0.0001]	[0.0001]	[0.0001]
GDP per capita			0.529		0.345			-0.0006		-0.0004
			[0.324]		[0.324]			[0.0004]		[0.0004]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.924	0.934	0.936			0.464	0.576	0.593		
Moran I	-0.011	-0.011	-0.011	-0.011	-0.011	-0.013	-0.012	-0.012	-0.012	-0.012
Moran I p-value	0.242	0.252	0.264	0.244	0.250	0.178	0.214	0.215	0.214	0.212
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Number of Day Laborers					Average Wage of Day Laborers				
Summer Temperature				7.780***	6.947***				-0.00637**	-0.00543*
				[2.428]	[2.596]				[0.00315]	[0.00324]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number and wage of agricultural day laborers. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.11: The Effects of the Cholera in 1849 & 1854 on the Number of Mechanized Ploughs and Animal-Powered Threshing Machines per Day Laborer in 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Mechanized Ploughs per Day Laborer					Animal-Powered Threshing Machines per Day Laborer				
Share of Cholera Deaths in Population	67.29**	55.09*	58.35*	323.6***	369.9***	18.90*	18.32**	18.58**	2.708	3.002
	[28.36]	[29.67]	[29.65]	[117.4]	[135.1]	[9.529]	[8.501]	[8.516]	[7.922]	[7.940]
Deviation from Summer Rainfall in Year (t)		0.118	0.0718	-0.205	-0.359		-0.162***	-0.166***	-0.143***	-0.144***
(Baseline Years (t-1)-(t-25))		[0.516]	[0.543]	[0.643]	[0.696]		[0.0457]	[0.0450]	[0.0504]	[0.0501]
Land Suitability * Year Fixed Effects		-0.519	-0.53	-0.796*	-0.861*		0.0247*	0.0239	0.0408**	0.0404**
		[0.435]	[0.445]	[0.477]	[0.517]		[0.0145]	[0.0148]	[0.0187]	[0.0192]
Border Department * Year Fixed Effects		0.0973	0.111	-0.209	-0.223		-0.0342*	-0.0331	-0.0163	-0.0164
		[0.250]	[0.245]	[0.341]	[0.374]		[0.0205]	[0.0205]	[0.0235]	[0.0235]
Maritime Department * Year Fixed Effects		-0.398***	-0.394***	-0.276*	-0.248		-0.0331***	-0.0327***	-0.0402***	-0.0400***
		[0.106]	[0.105]	[0.154]	[0.170]		[0.0109]	[0.0109]	[0.0119]	[0.0119]
Share of Carboniferous Area * Year Fixed Effects		-0.876	-0.929	-0.998	-1.14		-0.0309	-0.0351	-0.0237	-0.0246
		[0.803]	[0.821]	[0.843]	[0.925]		[0.0304]	[0.0301]	[0.0333]	[0.0340]
GDP per capita			1.598		3.683			0.128		0.0234
			[2.543]		[2.667]			[0.167]		[0.189]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.615	0.672	0.674			0.354	0.488	0.49		
Moran I	-0.012	-0.011	-0.011	-0.011	-0.012	-0.011	-0.011	-0.011	-0.011	-0.011
Moran I p-value	0.209	0.238	0.236	0.218	0.216	0.243	0.24	0.24	0.254	0.253
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Mechanized Ploughs per Day Laborer					Animal-Powered Threshing Machines per Day Laborer				
Summer Temperature				-58.29***	-66.12***				-0.488	-0.537
				[16.49]	[18.28]				[1.531]	[1.549]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of mechanized ploughs and animal-powered threshing machines per day laborer. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.12: The Effects of the Cholera in 1849 & 1854 on the Number of Steam-Powered Threshing Machines per Day Laborer in 1852 & 1862

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	2SLS	2SLS
	Steam-Powered Threshing Machines per Day Laborer				
Share of Cholera Deaths in Population	-0.0137	-0.0422	-0.0420	0.00499	0.0100
	[0.0425]	[0.0436]	[0.0402]	[0.204]	[0.209]
Deviation from Summer Rainfall in Year (t)		-0.0003	-0.0003	-0.0003	-0.0003
(Baseline Years (t-1)-(t-25))		[0.0007]	[0.0006]	[0.0007]	[0.0006]
Land Suitability * Year Fixed Effects		0.000540***	0.000540***	0.000492*	0.000485*
		[0.000140]	[0.000145]	[0.000264]	[0.000282]
Border Department * Year Fixed Effects		0.0001	0.0001	0.00003	0.00003
		[0.000275]	[0.000269]	[0.000380]	[0.000385]
Maritime Department * Year Fixed Effects		-0.0003	-0.0003	-0.0003	-0.0003
		[0.000258]	[0.000256]	[0.000249]	[0.000240]
Share of Carboniferous Area * Year Fixed Effects		-0.0003	-0.0003	-0.0003	-0.0004
		[0.000871]	[0.000950]	[0.000880]	[0.000985]
GDP per capita			0.0001		0.0004
			[0.0043]		[0.0043]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Within R2	0.202	0.232	0.232		
Moran I	-0.011	-0.011	-0.011	-0.011	-0.011
Moran I p-value	0.243	0.240	0.240	0.254	0.253
Mean of Dependent Variable	0.002	0.002	0.002	0.002	0.002
Clusters	85	85	85	85	85
Observations	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population					
Summer Temperature				-0.180***	-0.179***
				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577
Reduced Form: the dependent variable is Steam-Powered Threshing Machines per Day Laborer					
Summer Temperature				-0.000899	-0.00179
				[0.0376]	[0.0383]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of steam-powered threshing machines per day laborer. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.13: The Effects of the Cholera in 1849 & 1854 on the Average Rent of 1^{st}, 2^{nd} and 3^{rd} Class Arable Land 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Rent Arable Land 1st Class					Rent Arable Land 2nd Class					Rent Arable Land 3rd Class				
Share of Cholera Deaths in Population	0.627	1.372	1.955	-1.149	2.489	0.901	1.065	1.471	0.0634	2.669	0.418	0.589	1.002	-1.811	0.707
	[1.675]	[1.695]	[1.687]	[4.842]	[4.941]	[1.726]	[1.571]	[1.603]	[4.073]	[3.860]	[2.413]	[2.398]	[2.414]	[5.832]	[5.669]
Deviation from Summer Rainfall in Year (t)		0.0115	0.00320	0.0145	0.00246		0.0417**	0.0359*	0.0429**	0.0343*		0.0494**	0.0436*	0.0523**	0.0440*
(Baseline Years (t-1)-(t-25))		[0.0226]	[0.0244]	[0.0231]	[0.0246]		[0.0192]	[0.0197]	[0.0198]	[0.0204]		[0.0243]	[0.0248]	[0.0259]	[0.0260]
Land Suitability * Year Fixed Effects		-0.0280*	-0.0299*	-0.0254	-0.0305**		-0.0146	-0.0159	-0.0135	-0.0172		-0.00271	-0.00406	-0.000239	-0.00374
		[0.0166]	[0.0163]	[0.0160]	[0.0151]		[0.0153]	[0.0148]	[0.0143]	[0.0134]		[0.0160]	[0.0151]	[0.0155]	[0.0142]
Border Department * Year Fixed Effects		-0.00769	-0.00530	-0.00481	-0.00588		0.00559	0.00725	0.00673	0.00597		-2.12e-06	0.00168	0.00274	0.00200
		[0.00919]	[0.00944]	[0.00920]	[0.00946]		[0.00774]	[0.00824]	[0.00827]	[0.00825]		[0.00918]	[0.00957]	[0.0107]	[0.0103]
Maritime Department * Year Fixed Effects		-0.00175	-0.000984	-0.00290	-0.000734		0.00335	0.00389	0.00290	0.00445		-0.000313	0.000231	-0.00141	9.37e-05
		[0.00942]	[0.00899]	[0.00970]	[0.00886]		[0.00704]	[0.00688]	[0.00716]	[0.00701]		[0.00921]	[0.00913]	[0.00986]	[0.00963]
Share of Carboniferous Area * Year Fixed Effects		-0.0445	-0.0541	-0.0433	-0.0544		-0.0212	-0.0279	-0.0207	-0.0287		0.00192	-0.00487	0.00302	-0.00467
		[0.0377]	[0.0396]	[0.0363]	[0.0384]		[0.0296]	[0.0286]	[0.0284]	[0.0272]		[0.0331]	[0.0318]	[0.0316]	[0.0300]
GDP per capita			0.286*		0.290*			0.200**		0.208**			0.203*		0.201*
			[0.169]		[0.173]			[0.0905]		[0.0961]			[0.113]		[0.115]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.774	0.783	0.791			0.879	0.887	0.892			0.865	0.872	0.876		
Moran I	-0.011	-0.011	-0.012	-0.011	-0.012	-0.011	-0.011	-0.010	-0.011	-0.010	-0.011	-0.011	-0.011	-0.011	-0.011
Moran I p-value	0.229	0.231	0.222	0.230	0.222	0.275	0.273	0.276	0.272	0.277	0.267	0.263	0.262	0.261	0.262
Clusters	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population															
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is															
	Rent Arable Land 1st Class					Rent Arable Land 2nd Class					Rent Arable Land 3rd Class				
Summer Temperature				0.207	-0.445				-0.0114	-0.477				0.326	-0.126
				[0.885]	[0.913]				[0.753]	[0.745]				[1.043]	[1.051]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the average rent of 1^{st}, 2^{nd} and 3^{rd} class arable land. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.14: The Effects of the Cholera in 1849 & 1854 on the Average Rent of 1^{st}, 2^{nd} and 3^{rd} Class Meadows 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Rent Meadow 1st Class					Rent Meadow 2nd Class					Rent Meadow 3rd Class				
Share of Cholera Deaths in Population	-1.086	-0.187	0.391	5.435	9.795*	0.511	0.813	0.999	8.037	9.935*	0.348	1.953	2.076	-1.417	-0.913
	[1.600]	[1.835]	[1.764]	[4.764]	[5.166]	[2.102]	[2.475]	[2.437]	[5.447]	[5.605]	[2.337]	[2.329]	[2.243]	[9.774]	[9.396]
Deviation from Summer Rainfall in Year (t)		-0.0300	-0.0382*	-0.0368	-0.0512**		-0.0267	-0.0293	-0.0354	-0.0417		0.00749	0.00575	0.0116	0.00988
(Baseline Years (t-1)-(t-25))		[0.0223]	[0.0201]	[0.0232]	[0.0252]		[0.0256]	[0.0243]	[0.0278]	[0.0282]		[0.0356]	[0.0321]	[0.0414]	[0.0376]
Land Suitability * Year Fixed Effects		-0.0146	-0.0165	-0.0204	-0.0264*		-0.0127	-0.0133	-0.0202	-0.0228*		-0.0281	-0.0285	-0.0247	-0.0254
		[0.0143]	[0.0139]	[0.0135]	[0.0139]		[0.0140]	[0.0137]	[0.0140]	[0.0136]		[0.0183]	[0.0181]	[0.0177]	[0.0165]
Border Department * Year Fixed Effects		-0.0144	-0.0120	-0.0208*	-0.0221		-0.00994	-0.00918	-0.0182	-0.0187		-0.00375	-0.00325	9.35e-05	-5.42e-05
		[0.00923]	[0.00929]	[0.0114]	[0.0134]		[0.00918]	[0.00974]	[0.0122]	[0.0130]		[0.0116]	[0.0122]	[0.0157]	[0.0155]
Maritime Department * Year Fixed Effects		-0.00223	-0.00146	0.000338	0.00294		-0.00959	-0.00934	-0.00629	-0.00516		0.0114	0.0116	0.00990	0.0102
		[0.00865]	[0.00794]	[0.00914]	[0.00901]		[0.0113]	[0.0115]	[0.0115]	[0.0121]		[0.0124]	[0.0123]	[0.0139]	[0.0136]
Share of Carboniferous Area * Year Fixed Effects		0.00665	-0.00289	0.00408	-0.00924		-0.00912	-0.0122	-0.0124	-0.0182		0.0870	0.0850	0.0885	0.0870
		[0.0277]	[0.0274]	[0.0274]	[0.0291]		[0.0305]	[0.0296]	[0.0310]	[0.0315]		[0.0873]	[0.0868]	[0.0869]	[0.0873]
GDP per capita			0.284***		0.347***			0.0913		0.151			0.0601		0.0401
			[0.0838]		[0.117]			[0.133]		[0.156]			[0.196]		[0.181]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.782	0.791	0.804			0.773	0.780	0.781			0.531	0.561	0.561		
Moran I	-0.011	-0.011	-0.011	-0.011	-0.011	-0.013	-0.013	-0.013	-0.013	-0.013	-0.011	-0.012	-0.012	-0.012	-0.012
Moran I p-value	0.240	0.226	0.224	0.225	0.223	0.160	0.163	0.162	0.170	0.168	0.221	0.208	0.205	0.207	0.204
Clusters	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population															
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577				14.602	13.577
	Rent Meadow 1st Class					Rent Meadow 2nd Class					Rent Meadow 3rd Class				
Summer Temperature				-0.979	-1.751*				-1.448	-1.776*				0.255	0.163
				[0.905]	[0.897]				[1.043]	[1.038]				[1.791]	[1.718]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the average rent of 1^{st}, 2^{nd} and 3^{rd} class meadows. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table E.15: The Effects of the Cholera in 1849 & 1854 on the Average Rent of 1^{st}, 2^{nd} and 3^{rd} Vineyard 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Rent Vineyard 1st Class					Rent Vineyard 2nd Class					Rent Vineyard 3rd Class				
Share of Cholera Deaths in Population	1.090	5.325	4.293	14.94	8.964	4.375	5.368	4.513	30.88	27.54	3.006	6.194	5.154	22.68	17.29
	[4.904]	[5.534]	[5.125]	[29.61]	[29.51]	[4.119]	[4.681]	[4.171]	[23.60]	[21.71]	[4.562]	[5.233]	[4.815]	[25.59]	[24.94]
Deviation from Summer Rainfall in Year (t)		0.114	0.129	0.103	0.123		0.123*	0.135*	0.0920	0.103		0.121	0.136*	0.102	0.120
(Baseline Years (t-1)-(t-25))		[0.0853]	[0.0904]	[0.0972]	[0.102]		[0.0705]	[0.0734]	[0.0914]	[0.0915]		[0.0749]	[0.0774]	[0.0885]	[0.0890]
Land Suitability * Year Fixed Effects		-0.186	-0.182	-0.195	-0.187		-0.0510	-0.0482	-0.0772	-0.0726		-0.153	-0.149	-0.170	-0.162
		[0.154]	[0.152]	[0.151]	[0.145]		[0.0599]	[0.0565]	[0.0758]	[0.0712]		[0.116]	[0.113]	[0.117]	[0.113]
Border Department * Year Fixed Effects		-0.0222	-0.0264	-0.0332	-0.0314		0.0104	0.00693	-0.0187	-0.0177		-0.00958	-0.0138	-0.0284	-0.0268
		[0.0395]	[0.0396]	[0.0373]	[0.0358]		[0.0179]	[0.0171]	[0.0370]	[0.0351]		[0.0330]	[0.0326]	[0.0378]	[0.0357]
Maritime Department * Year Fixed Effects		0.0148	0.0135	0.0192	0.0156		0.0243	0.0232	0.0360	0.0340		0.0123	0.0109	0.0198	0.0166
		[0.0433]	[0.0431]	[0.0442]	[0.0430]		[0.0372]	[0.0367]	[0.0380]	[0.0357]		[0.0373]	[0.0369]	[0.0386]	[0.0372]
Share of Carboniferous Area * Year Fixed Effects		-0.375	-0.358	-0.380*	-0.361*		-0.177	-0.163*	-0.189*	-0.179*		-0.293	-0.276	-0.301*	-0.284*
		[0.228]	[0.218]	[0.221]	[0.208]		[0.107]	[0.0941]	[0.112]	[0.101]		[0.178]	[0.169]	[0.176]	[0.165]
GDP per capita			-0.507		-0.476			-0.420		-0.266			-0.511		-0.430
			[0.541]		[0.510]			[0.463]		[0.416]			[0.502]		[0.470]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Within R2	0.208	0.285	0.290			0.276	0.304	0.310			0.300	0.366	0.373		
Moran I	-0.010	-0.010	-0.010	-0.010	-0.010	-0.012	-0.012	-0.012	-0.012	-0.012	-0.011	-0.011	-0.011	-0.011	-0.011
Moran I p-value	0.296	0.294	0.290	0.288	0.279	0.229	0.213	0.219	0.213	0.219	0.243	0.252	0.244	0.252	0.245
Clusters	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population														
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is														
	Rent Vineyard 1st Class					Rent Vineyard 2nd Class					Rent Vineyard 3rd Class				
Summer Temperature				-2.691	-1.602				-5.563	-4.924				-4.086	-3.091
				[5.502]	[5.465]				[4.278]	[3.935]				[4.784]	[4.667]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the average rent of 1^{st}, 2^{nd} and 3^{rd} class vineyards. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

Table E.16: The Effects of the Cholera in 1849 & 1854 on the Average Value of Harvested Wheat, Millet and Rye 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Value of Harvested Wheat					Average Value of Harvested Millet					Average Value of Harvested Rye				
Share of Cholera Deaths in Population	-1.019	-1.019	-0.769	-6.045**	-4.842**	0.767	1.349	1.709	18.56	22.54	-2.117	-2.749	-1.679	-16.19*	-10.31*
	[0.629]	[0.665]	[0.623]	[2.429]	[2.299]	[2.967]	[3.836]	[3.198]	[16.83]	[17.28]	[1.916]	[2.201]	[1.847]	[9.141]	[6.018]
Deviation from Summer Rainfall in Year (t)		-0.00328	-0.00685	0.00277	-0.00122		0.00940	0.00426	-0.0113	-0.0245		0.0547	0.0394	0.0708	0.0513
(Baseline Years (t-1)-(t-25))		[0.00923]	[0.00921]	[0.0129]	[0.0117]		[0.0381]	[0.0488]	[0.0460]	[0.0633]		[0.0484]	[0.0404]	[0.0588]	[0.0449]
Land Suitability * Year Fixed Effects		0.00450	0.00369	0.00968	0.00801		0.0123	0.0111	-0.00546	-0.0110		0.0214	0.0179	0.0353	0.0271
		[0.00620]	[0.00531]	[0.00667]	[0.00587]		[0.0193]	[0.0198]	[0.0221]	[0.0243]		[0.0206]	[0.0164]	[0.0263]	[0.0199]
Border Department * Year Fixed Effects		-0.000449	0.000576	0.00529	0.00493		-0.00245	-0.000972	-0.0221	-0.0233		0.0140	0.0183*	0.0293	0.0276*
		[0.00529]	[0.00528]	[0.00719]	[0.00651]		[0.0128]	[0.0131]	[0.0301]	[0.0321]		[0.00960]	[0.0103]	[0.0190]	[0.0153]
Maritime Department * Year Fixed Effects		0.00293	0.00326	0.000638	0.00136		0.0362	0.0367	0.0441	0.0464		0.0112	0.0126	0.00510	0.00860
		[0.00356]	[0.00359]	[0.00350]	[0.00343]		[0.0280]	[0.0273]	[0.0315]	[0.0304]		[0.00878]	[0.00825]	[0.0119]	[0.00986]
Share of Carboniferous Area * Year Fixed Effects		-0.00669	-0.0108	-0.00439	-0.00806		-0.151	-0.157	-0.159	-0.171		-0.00751	-0.0251	-0.00137	-0.0193
		[0.0149]	[0.0133]	[0.0144]	[0.0129]		[0.185]	[0.181]	[0.182]	[0.179]		[0.0309]	[0.0342]	[0.0333]	[0.0333]
GDP per capita			0.123***		0.0958**			0.177		0.317			0.526		0.468
			[0.0410]		[0.0428]			[0.458]		[0.483]			[0.328]		[0.293]
Department- & Year Fixed Efffects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.942	0.944	0.948			0.228	0.286	0.288			0.447	0.464	0.502		
Moran I	-0.012	-0.012	-0.012	-0.012	-0.012	-0.010	-0.010	-0.010	-0.010	-0.010	-0.009	-0.009	-0.009	-0.010	-0.009
Moran I p-value	0.222	0.215	0.217	0.222	0.220	0.302	0.304	0.301	0.300	0.295	0.310	0.306	0.303	0.296	0.296
Clusters	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population															
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is															
	Average Value of Harvested Wheat					Average Value of Harvested Mullet					Average Value of Harvested Rye				
Summer Temperature				1.089***	0.866**				-3.343	-4.029				2.915*	1.844*
				[0.332]	[0.353]				[3.117]	[3.094]				[1.550]	[1.059]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the average value of harvested wheat, millet and rye. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table E.17: The Effects of the Cholera in 1849 & 1854 on the Average Value of Harvested Oats and Corn 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Value of Harvested Oats					Average Value of Harvested Corn				
Share of Cholera Deaths in Population	0.853	0.890	1.104	2.030	3.551	9.575	-0.364	5.242	18.17	-17.88
	[1.850]	[2.108]	[2.067]	[6.685]	[7.936]	[8.460]	[8.925]	[9.391]	[49.56]	[51.04]
Deviation from Summer Rainfall in Year (t)		0.0857*	0.0827	0.0844	0.0793		0.369**	0.289*	0.273	0.393*
(Baseline Years (t-1)-(t-25))		[0.0513]	[0.0536]	[0.0533]	[0.0575]		[0.176]	[0.146]	[0.167]	[0.210]
Land Suitability * Year Fixed Effects		0.0517	0.0510	0.0505	0.0484		0.264***	0.245**	0.232*	0.282***
		[0.0545]	[0.0541]	[0.0491]	[0.0479]		[0.0924]	[0.112]	[0.120]	[0.0965]
Border Department * Year Fixed Effects		0.00734	0.00822	0.00604	0.00560		0.0785*	0.101*	0.0866	0.0972
		[0.0176]	[0.0179]	[0.0119]	[0.0117]		[0.0467]	[0.0523]	[0.0844]	[0.0811]
Maritime Department * Year Fixed Effects		0.0254**	0.0257**	0.0260**	0.0269***		0.0327	0.0401	0.0460	0.0245
		[0.0103]	[0.0103]	[0.0102]	[0.0104]		[0.0653]	[0.0737]	[0.0797]	[0.0692]
Share of Carboniferous Area * Year Fixed Effects		0.0795	0.0760	0.0790	0.0743		0.951	0.859	0.853	0.963
		[0.0773]	[0.0760]	[0.0734]	[0.0706]		[0.696]	[0.703]	[0.696]	[0.689]
GDP per capita			0.105		0.121		-2.753**			-2.870**
			[0.124]		[0.148]		[1.343]			[1.432]
Department- & Year Fixed Efffects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.351	0.436	0.438			0.010	0.167	0.110		
Moran I	-0.014	-0.014	-0.014	-0.014	-0.014	-0.009	-0.009	-0.009	-0.009	-0.009
Moran I p-value	0.120	0.128	0.125	0.129	0.128	0.345	0.339	0.349	0.338	0.348
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Average Value of Harvested Oats					Average Value of Harvested Corn				
Summer Temperature				-0.366	-0.635				-3.272	3.196
				[1.211]	[1.419]				[9.040]	[9.346]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the average value of harvested oats and corn. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table E.18: The Effects of Cholera in 1832, 1849 & 1854 on the number of patents and the Share of Agricultural Hydraulic Patents in the Ten Years following each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Total Number of Patents					Share of Agricultural Hydraulic Patents				
	Year t+1 to t+10									
Share of Cholera Deaths in Population	2.307	0.500	1.525	27.69*	29.69*	0.127	-0.0260	-0.00630	4.047**	4.106**
	[9.408]	[9.496]	[8.919]	[15.52]	[15.47]	[0.413]	[0.433]	[0.425]	[1.728]	[1.783]
Deviation from Summer Rainfall in Year (t)		-0.0785	-0.0941	-0.0842	-0.101		0.00241	0.00211	0.00155	0.00104
(Baseline Years (t-1)-(t-25))		[0.0573]	[0.0603]	[0.0596]	[0.0643]		[0.00530]	[0.00546]	[0.00504]	[0.00530]
Land Suitability * Year Fixed Effects		0.0250	0.0265	0.0214	0.0229		0.00183	0.00186	0.00129	0.00134
		[0.0187]	[0.0176]	[0.0189]	[0.0175]		[0.00168]	[0.00165]	[0.00164]	[0.00160]
Border Department * Year Fixed Effects		0.00826	0.00775	0.00338	0.00267		0.000886	0.000876	0.000156	0.000135
		[0.00747]	[0.00743]	[0.00733]	[0.00730]		[0.000926]	[0.000928]	[0.000956]	[0.000957]
Maritime Department * Year Fixed Effects		-0.00124	-0.00219	-0.00264	-0.00373		-0.000716	-0.000735	-0.000927	-0.000959
		[0.0103]	[0.0101]	[0.0102]	[0.00979]		[0.000835]	[0.000839]	[0.000821]	[0.000820]
Share of Carboniferous Area * Year Fixed Effects		0.0858**	0.0773*	0.0792**	0.0697*		0.00344	0.00327	0.00245	0.00217
		[0.0401]	[0.0394]	[0.0391]	[0.0383]		[0.00373]	[0.00384]	[0.00364]	[0.00372]
GDP per capita			0.969**		1.057**			0.0186		0.0315
			[0.426]		[0.478]			[0.0323]		[0.0388]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.692	0.708	0.718			0.003	0.031	0.032		
Moran I	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.236	0.223	0.230	0.227	0.234	0.219	0.220	0.220	0.226	0.226
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	255	255	255	255	255	255	255	255	255	255
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.141***	-0.140***				-0.141***	-0.140***
				[0.0303]	[0.0308]				[0.0303]	[0.0308]
1st stage F-stat				21.652	20.788				21.652	20.788
Reduced Form: the dependent variable is										
	Total Number of Patents					Share of Agricultural Hydraulic Patents				
	Year t+1 to t+10									
Summer Temperature				-3.900	-4.165*				-0.570***	-0.576***
				[2.364]	[2.257]				[0.209]	[0.211]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of patents and the share of agricultural hydraulic patents in the decade after each outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

F. Effects of the Cholera Pandemics on the Number of Machines in Industry and Agriculture

Table F.1: The Effects of the Cholera in 1849 & 1854 on the Number of Boilers and Steam Generators in the Year following each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Number of Steam Generators Year t+1					Number of Boilers Year t+1				
Share of Cholera Deaths in Population	-21.16***	-21.44***	-20.32***	-47.21**	-42.14**	-15.46	-19.03**	-19.75***	-71.52**	-81.12**
	[7.417]	[7.403]	[7.252]	[18.62]	[18.19]	[9.322]	[7.322]	[7.448]	[30.88]	[33.68]
GDP per capita			0.550		0.404			-0.354		-0.765
			[0.511]		[0.517]			[0.625]		[0.805]
Deviation from Summer Rainfall in Year (t)		0.124	0.108	0.155	0.138		-0.346***	-0.336**	-0.283*	-0.251
(Baseline Years (t-1)-(t-25))		[0.0805]	[0.0759]	[0.0944]	[0.0872]		[0.130]	[0.129]	[0.167]	[0.178]
Land Suitability * Year Fixed Effects		0.0378	0.0342	0.0644	0.0573		0.199**	0.202**	0.253***	0.267***
		[0.0430]	[0.0449]	[0.0432]	[0.0419]		[0.0808]	[0.0777]	[0.0817]	[0.0770]
Border Department * Year Fixed Effects		-0.00674	-0.00217	0.0227	0.0212		-0.0368	-0.0397	0.0231	0.0259
		[0.0283]	[0.0287]	[0.0395]	[0.0386]		[0.0381]	[0.0388]	[0.0687]	[0.0742]
Maritime Department * Year Fixed Effects		-0.00350	-0.00202	-0.0153	-0.0122		-0.00424	-0.00520	-0.0282	-0.0339
		[0.0268]	[0.0258]	[0.0279]	[0.0256]		[0.0472]	[0.0472]	[0.0468]	[0.0474]
Share of Carboniferous Area * Year Fixed Effects		0.00522	-0.0132	0.0170	0.00152		-0.0447	-0.0328	-0.0207	0.00860
		[0.0992]	[0.108]	[0.0967]	[0.103]		[0.159]	[0.159]	[0.150]	[0.148]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.475	0.491	0.498			0.398	0.526	0.528		
Moran I	-0.010	-0.010	-0.010	-0.010	-0.010	-0.011	-0.012	-0.012	-0.012	-0.012
Moran I p-value	0.278	0.282	0.282	0.281	0.281	0.248	0.226	0.228	0.225	0.231
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Number of Steam Generators Year t+1					Number of Boilers Year t+1				
Summer Temperature				8.504**	7.534**				12.88**	14.50**
				[3.508]	[3.468]				[6.021]	[5.928]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of boilers and steam generators in the mining sector in the year after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table F.2: The Effects of the Cholera in 1849 & 1854 on the Number and Horse Power of Steam-Powered Machines in the Year following each Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Number of Steam-Powered Machines Year t+1					Horse Power of Steam-Powered Machines Year t+1				
Share of Cholera Deaths in Population	-24.14***	-25.35***	-24.26***	-39.20**	-33.21**	-31.21**	-27.49**	-26.75**	-56.69**	-54.50*
	[7.076]	[6.428]	[6.285]	[16.47]	[15.52]	[13.46]	[12.46]	[12.17]	[28.12]	[28.45]
GDP per capita			0.536		0.477			0.360		0.175
			[0.467]		[0.453]			[0.933]		[0.963]
Deviation from Summer Rainfall in Year (t)		0.115	0.0993	0.132	0.112		0.0654	0.0549	0.101	0.0933
(Baseline Years (t-1)-(t-25))		[0.0867]	[0.0818]	[0.0924]	[0.0844]		[0.130]	[0.120]	[0.145]	[0.134]
Land Suitability * Year Fixed Effects		0.0920***	0.0885***	0.106***	0.0980***		0.0151	0.0127	0.0452	0.0421
		[0.0277]	[0.0305]	[0.0329]	[0.0332]		[0.0802]	[0.0803]	[0.0773]	[0.0731]
Border Department * Year Fixed Effects		-0.0106	-0.00611	0.00523	0.00347		-0.0761*	-0.0731	-0.0428	-0.0434
		[0.0273]	[0.0287]	[0.0354]	[0.0353]		[0.0448]	[0.0444]	[0.0574]	[0.0580]
Maritime Department * Year Fixed Effects		-0.0117	-0.0103	-0.0180	-0.0145		-0.0174	-0.0164	-0.0307	-0.0294
		[0.0248]	[0.0241]	[0.0244]	[0.0231]		[0.0487]	[0.0474]	[0.0502]	[0.0460]
Share of Carboniferous Area * Year Fixed Effects		0.0868	0.0688	0.0931	0.0748		0.175	0.163	0.189	0.182
		[0.0779]	[0.0846]	[0.0792]	[0.0848]		[0.200]	[0.214]	[0.197]	[0.211]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.557	0.591	0.599			0.322	0.347	0.348		
Moran I	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011
Moran I p-value	0.256	0.262	0.259	0.262	0.259	0.257	0.260	0.260	0.263	0.263
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Number of Steam-Powered Machines Year t+1					Horse Power of Steam-Powered Machines Year t+1				
Summer Temperature				7.061**	5.938*				10.21*	9.743*
				[3.206]	[3.120]				[5.201]	[5.197]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number and horse power of steam-powered machines in the mining sector in the year after each cholera outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

Table F.3: The Effects of the Cholera in 1849 & 1854 on the Number of Mechanized Ploughs, Animal-Powered Threshing Machines and Steam-Powered Threshing Machines in 1852 & 1862

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Mechanized Ploughs					Animal-Powered Threshing Machines					Steam-Powered Threshing Machines				
Share of Cholera Deaths in Population	-13,060	-47,351	-27,077	-399,870	-297,577	-1,084	-1,252	-1,271*	-2,832	-3,102	6,424	6,555	6,608	-86,210**	-94,372**
	[74,800]	[72,742]	[70,494]	[299,471]	[293,179]	[686.6]	[767.2]	[657.9]	[2,300]	[1,947]	[14,609]	[13,443]	[12,819]	[39,697]	[40,839]
Deviation from Summer Rainfall in Year (t)		915.9	627.1	1,341	1,001		-6.189	-5.921	-4.285	-3.390		-378.7***	-379.4***	-266.9	-239.8
(Baseline Years (t-1)-(t-25))		[1,070]	[1,044]	[1,291]	[1,147]		[7.719]	[7.468]	[8.642]	[8.476]		[122.7]	[131.3]	[199.8]	[224.8]
Land Suitability * Year Fixed Effects		1,686**	1,620**	2,050**	1,907**		4.836***	4.897**	6.464**	6.840**		146.3	146.1	241.9**	253.2**
		[842.4]	[788.4]	[820.6]	[745.3]		[1.831]	[2.121]	[2.710]	[3.100]		[89.90]	[88.93]	[113.4]	[116.6]
Border Department * Year Fixed Effects		-289.5	-206.7	112.7	82.71		3.114	3.037	4.917	4.996		-78.92	-78.71	26.92	29.31
		[372.5]	[387.7]	[578.9]	[526.2]		[3.833]	[3.452]	[4.587]	[4.795]		[65.37]	[61.82]	[106.4]	[113.6]
Maritime Department * Year Fixed Effects		-562.4	-535.6	-723.2*	-662.2		1.368	1.343	0.647	0.487		-23.03	-22.96	-65.34	-70.20
		[417.1]	[431.9]	[430.1]	[447.7]		[4.827]	[4.671]	[5.013]	[4.549]		[60.03]	[58.56]	[66.37]	[64.39]
Share of Carboniferous Area * Year Fixed Effects		1,370	1,036	1,531	1,219		12.22	12.53	12.95	13.77		247.2	246.3	289.6	314.5
		[1,666]	[1,537]	[1,657]	[1,540]		[16.88]	[19.36]	[16.42]	[19.25]		[218.3]	[231.3]	[236.5]	[260.9]
GDP per capita			9,957*		8,146			-9.216		-21.47			25.84		-649.9
			[5,331]		[6,159]			[89.91]		[88.30]			[1,121]		[1,305]
Department- & Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No	No	Yes	Yes
GDP per capita	No	No	No	No	Yes	No	No	No	No	Yes	No	No	No	No	Yes
Within R2	0.418	0.486	0.503			0.025	0.036	0.036			0.108	0.166	0.166		
Moran I	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.011	-0.012	-0.012	-0.012	-0.012	-0.012
Moran I p-value	0.264	0.262	0.257	0.262	0.259	0.207	0.208	0.208	0.208	0.209	0.218	0.221	0.221	0.227	0.229
Clusters	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population															
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is															
	Mechanized Ploughs					Animal-Powered Threshing Machines					Steam-Powered Threshing Machines				
Summer Temperature				72,026	53,197				510.2	554.5				15,529**	16,870***
				[46,695]	[48,954]				[457.5]	[395.8]				[6,469]	[5,951]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of mechanized ploughs and animal-powered threshing machines. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

G. Main Regression Results, Accounting for Spatial Autocorrelation

Table G.1: The Effects of the Cholera in 1849 & 1854 on the Number and Wage of Agricultural Day Laborers in 1852 & 1862, Accounting for Spatial Autocorrelation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Number of Day Laborers					Average Wage of Day Laborers				
Share of Cholera Deaths in Population	-15.74***	-12.41**	-11.35**	-43.19***	-38.86***	0.00627	0.00447	0.00354	0.0353**	0.0304*
	[5.502]	[5.369]	[5.369]	[14.68]	[14.63]	[0.00483]	[0.00566]	[0.00585]	[0.0179]	[0.0182]
Deviation from Summer Rainfall in Year (t)		0.125**	0.108*	0.162*	0.148*		3.54e-05	4.93e-05	-4.15e-06	1.24e-05
		[0.0610]	[0.0634]	[0.0844]	[0.0784]		[7.35e-05]	[7.85e-05]	[8.35e-05]	[8.09e-05]
Land Suitability * Year Fixed Effects		-0.00466	-0.00885	0.0274	0.0214		-9.83e-05	-9.49e-05	-0.000129	-0.000122
		[0.0671]	[0.0636]	[0.0688]	[0.0645]		[6.85e-05]	[6.36e-05]	[8.15e-05]	[7.71e-05]
Border Department * Year Fixed Effects		-0.0337	-0.0271	0.000353	-0.000918		3.91e-05	3.41e-05	-2.22e-06	-7.63e-07
		[0.0330]	[0.0320]	[0.0444]	[0.0412]		[3.65e-05]	[3.58e-05]	[4.26e-05]	[4.03e-05]
Maritime Department * Year Fixed Effects		0.0237	0.0295	0.00743	0.0100		-3.10e-05**	-3.42e-05**	-3.25e-05*	-3.55e-05*
		[0.0259]	[0.0252]	[0.0239]	[0.0240]		[1.43e-05]	[1.44e-05]	[1.95e-05]	[1.97e-05]
Share of Carboniferous Area * Year Fixed Effects		0.0569	0.0384	0.0711	0.0579		-0.000220*	-0.000204*	-0.000241*	-0.000225*
		[0.111]	[0.106]	[0.116]	[0.111]		[0.000119]	[0.000108]	[0.000131]	[0.000122]
GDP per capita			0.541*		0.345			-0.000493		-0.000396
			[0.315]		[0.324]			[0.000357]		[0.000369]
ρ	-0.423	-0.124	-0.374			2.752***	2.534***	2.220***		
	[0.806]	[0.998]	[0.999]			[0.220]	[0.351]	[0.527]		
σ^2	0.0470***	0.0408***	0.0394***			4.50e-08***	3.63e-08***	3.53e-08***		
	[0.00967]	[0.00884]	[0.00874]			[1.69e-08]	[8.92e-09]	[8.26e-09]		
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.924	0.934	0.936			0.468	0.577	0.597		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature					-0.179***				-0.180***	-0.179***
					[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is	Number of Day Laborers					Average Wage of Day Laborers				
Summer Temperature					6.947***				-0.00637**	-0.00543*
					[2.596]				[0.00315]	[0.00324]

Note: This table reports panel data regressions that account for spatial autocorrelation where we use a weighting matrix based on the great-circle distance between the department's administrative centers. Columns 1-3 and 6-7 are estimated using the *xsmle* Stata command (Belotti et al., 2013) while Columns 4-5 and 8-10 are estimated using the *xtivreg2* Stata command (Schaffer, 2005). Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table G.2: The Effects of the Cholera 1849 & 1854 on the Number of Mechanized Ploughs and Animal-Powered Threshing Machines per Day Laborer in 1852 & 1862, Accounting for Spatial Autocorrelation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Ploughs per Day Laborer					Animal-Powered Threshing Machines per Day Laborer				
Share of Cholera Deaths in Population	58.75**	52.49*	55.64*	323.6***	369.9***	17.42**	17.37**	17.68**	2.708	3.002
	[26.67]	[28.82]	[28.61]	[117.4]	[135.1]	[8.766]	[7.968]	[7.940]	[7.922]	[7.940]
Deviation from Summer Rainfall in Year (t)		0.0837	0.0327	-0.205	-0.359		-0.134***	-0.138***	-0.143***	-0.144***
		[0.506]	[0.533]	[0.643]	[0.696]		[0.0426]	[0.0419]	[0.0504]	[0.0501]
Land Suitability * Year Fixed Effects		-0.516	-0.527	-0.796*	-0.861*		0.0204	0.0193	0.0408**	0.0404**
		[0.427]	[0.435]	[0.477]	[0.517]		[0.0141]	[0.0142]	[0.0187]	[0.0192]
Border Department * Year Fixed Effects		0.110	0.125	-0.209	-0.223		-0.0304	-0.0290	-0.0163	-0.0164
		[0.242]	[0.236]	[0.341]	[0.374]		[0.0192]	[0.0191]	[0.0235]	[0.0235]
Maritime Department * Year Fixed Effects		-0.359***	-0.352***	-0.276*	-0.248		-0.0223**	-0.0218**	-0.0402***	-0.0400***
		[0.100]	[0.0979]	[0.154]	[0.170]		[0.0101]	[0.00997]	[0.0119]	[0.0119]
Share of Carboniferous Area * Year Fixed Effects		-0.887	-0.944	-0.998	-1.140		-0.0290	-0.0342	-0.0237	-0.0246
		[0.791]	[0.806]	[0.843]	[0.925]		[0.0292]	[0.0284]	[0.0333]	[0.0340]
GDP per capita			1.656		3.683			0.156		0.0234
			[2.471]		[2.667]			[0.151]		[0.189]
ρ	2.289***	0.862	0.935			3.416***	3.073***	3.101***		
	[0.498]	[0.882]	[0.902]			[0.126]	[0.316]	[0.284]		
σ^2	2.367***	2.090***	2.076***			0.0192***	0.0164***	0.0162***		
	[0.672]	[0.517]	[0.508]			[0.00582]	[0.00445]	[0.00445]		
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes	No	No	Yes	No	Yes
Within R2	0.614	0.669	0.670			0.347	0.495	0.500		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Ploughs per Day Laborer					Animal-Powered Threshing Machines per Day Laborer				
Summer Temperature				-58.29***	-66.12***				-0.488	-0.537
				[16.49]	[18.28]				[1.531]	[1.549]

Note: This table reports panel data regressions that account for spatial autocorrelation where we use a weighting matrix based on the great-circle distance between the department's administrative centers. Columns 1-3 and 6-7 are estimated using the *xsmle* Stata command (Belotti et al., 2013) while Columns 4-5 and 8-10 are estimated using the *xtivreg2* Stata command (Schaffer, 2005). Robust standard errors clustered at the department level. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

Table G.3: The Effects of the Cholera in 1849 & 1854 on the Number and Horse Power of Steam-Powered Machines per Worker in the Year following each Pandemic, Accounting for Spatial Autocorrelation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Steam Generators per Worker Year t+1					Average Number of Boilers per Worker Year t+1				
Share of Cholera Deaths in Population	-18.42**	-24.23**	-22.10**	-86.21**	-74.20**	-9.890	-15.64*	-16.04*	-90.47**	-99.37**
	[8.369]	[9.816]	[9.091]	[34.05]	[30.86]	[9.001]	[9.318]	[9.358]	[38.90]	[41.65]
Deviation from Summer Rainfall in Year (t)		0.0274	-0.00594	0.0832	0.0434		-0.292**	-0.286**	-0.274	-0.244
(Baseline Years (t-1)-(t-25))		[0.129]	[0.127]	[0.160]	[0.144]		[0.140]	[0.144]	[0.194]	[0.214]
Land Suitability * Year Fixed Effects		-0.0163	-0.0231	0.0564	0.0397		0.0531	0.0544	0.150***	0.163***
		[0.0505]	[0.0521]	[0.0540]	[0.0478]		[0.0581]	[0.0575]	[0.0563]	[0.0565]
Border Department * Year Fixed Effects		0.0712**	0.0801**	0.129*	0.126*		0.0439	0.0423	0.105	0.108
		[0.0356]	[0.0372]	[0.0708]	[0.0648]		[0.0419]	[0.0428]	[0.0882]	[0.0940]
Maritime Department * Year Fixed Effects		-0.0492	-0.0469	-0.0905	-0.0834		-0.0300	-0.0305	-0.0902	-0.0955*
		[0.0478]	[0.0453]	[0.0581]	[0.0518]		[0.0517]	[0.0512]	[0.0585]	[0.0580]
Share of Carboniferous Area * Year Fixed Effects		-0.185	-0.224*	-0.174	-0.211		-0.0995	-0.0928	-0.104	-0.0768
		[0.130]	[0.134]	[0.141]	[0.137]		[0.128]	[0.127]	[0.124]	[0.126]
GDP per capita			1.124		0.956			-0.198		-0.709
			[0.720]		[0.693]			[0.667]		[0.933]
ρ	2.904***	2.858***	2.720***			3.331***	3.152***	3.154***		
	[0.350]	[0.408]	[0.470]			[0.161]	[0.254]	[0.250]		
σ^2	0.197***	0.187***	0.181***			0.216***	0.190***	0.190***		
	[0.0553]	[0.0506]	[0.0461]			[0.0441]	[0.0448]	[0.0450]		
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.132	0.188	0.225			0.193	0.343	0.342		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
Reduced Form: the dependent variable is										
	Average Number of Steam Generators per Worker Year t+1					Average Number of Boilers per Worker Year t+1				
Summer Temperature				15.53**	13.26**				16.30**	17.76**
				[6.325]	[5.718]				[7.479]	[7.237]

Note: This table reports panel data regressions that account for spatial autocorrelation where we use a weighting matrix based on the great-circle distance between the department's administrative centers. Columns 1-3 and 6-7 are estimated using the *xsmle* Stata command (Belotti et al., 2013) while Columns 4-5 and 8-10 are estimated using the *xtivreg2* Stata command (Schaffer, 2005). Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table G.4: The Effects of the Cholera in 1849 & 1854 on the Number of Boilers and Steam Generators per Worker in the Year following each Pandemic, Accounting for Spatial Autocorrelation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Number of Workers Year t+1					Average Wage per Worker Year t+1				
Share of Cholera Deaths in Population	-21.60***	-27.74***	-25.87***	-75.52**	-64.49**	-30.53**	-35.04**	-32.86**	-104.7**	-91.55**
	[8.026]	[9.114]	[8.368]	[31.71]	[28.28]	[13.53]	[14.82]	[14.22]	[46.60]	[43.80]
Deviation from Summer Rainfall in Year (t)		0.0165	-0.0124	0.0532	0.0166		0.0306	-0.00782	0.112	0.0685
(Baseline Years (t-1)-(t-25))		[0.131]	[0.130]	[0.147]	[0.134]		[0.183]	[0.176]	[0.214]	[0.194]
Land Suitability * Year Fixed Effects		0.0149	0.00887	0.0726	0.0572		-0.00851	-0.0157	0.0687	0.0504
		[0.0467]	[0.0494]	[0.0485]	[0.0449]		[0.0645]	[0.0660]	[0.0736]	[0.0664]
Border Department * Year Fixed Effects		0.0650*	0.0727*	0.106*	0.103*		0.0387	0.0484	0.109	0.105
		[0.0351]	[0.0378]	[0.0635]	[0.0588]		[0.0536]	[0.0556]	[0.0911]	[0.0870]
Maritime Department * Year Fixed Effects		-0.0511	-0.0490	-0.0863	-0.0797		-0.0624	-0.0605	-0.101	-0.0932
		[0.0462]	[0.0441]	[0.0540]	[0.0487]		[0.0702]	[0.0678]	[0.0828]	[0.0748]
Share of Carboniferous Area * Year Fixed Effects		-0.152	-0.185	-0.143	-0.177		-0.0796	-0.126	-0.0565	-0.0967
		[0.114]	[0.118]	[0.125]	[0.121]		[0.212]	[0.222]	[0.222]	[0.229]
GDP per capita			0.974		0.878			1.329		1.049
			[0.691]		[0.652]			[1.115]		[1.126]
ρ	2.976***	2.898***	2.785***			1.710	1.594	1.258		
	[0.322]	[0.412]	[0.465]			[1.086]	[1.142]	[1.233]		
σ^2	0.168***	0.158***	0.154***			0.470***	0.464***	0.456***		
	[0.0480]	[0.0438]	[0.0392]			[0.139]	[0.137]	[0.132]		
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.172	0.232	0.263			0.124	0.136	0.156		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.180***	-0.179***				-0.180***	-0.179***
				[0.0471]	[0.0485]				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577				14.602	13.577
	Reduced Form: the dependent variable is									
	Average Number of Workers Year t+1					Average Wage per Worker Year t+1				
Summer Temperature				13.60**	11.53**				18.86**	16.37**
				[5.977]	[5.357]				[8.808]	[8.172]

Note: This table reports panel data regressions that account for spatial autocorrelation where we use a weighting matrix based on the great-circle distance between the department's administrative centers. Columns 1-3 and 6-7 are estimated using the *xsmle* Stata command (Belotti et al., 2013) while Columns 4-5 and 8-10 are estimated using the *xtivreg2* Stata command (Schaffer, 2005). Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table G.5: The Effects of the Cholera in 1849 & 1854 on the Values of Extracted Coal & Peat Two and Three Years after each Pandemic, Accounting for Spatial Autocorrelation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Average Value of Extracted Coal (t+2)-(t+3)					Average Value of Extracted Peat (t+2)-(t+3)				
Share of Cholera Deaths in Population	-2.718	-2.382	-2.610	2.732	3.615	-8.036*	-10.59**	-10.10*	-25.95**	-24.71*
	[2.227]	[1.733]	[1.760]	[6.724]	[6.429]	[4.506]	[5.057]	[5.222]	[12.06]	[13.79]
Deviation from Summer Rainfall in Year (t)		-0.0464	-0.0431	-0.0504	-0.0533		-0.0786	-0.0841	-0.0674	-0.0715
(Baseline Years (t-1)-(t-25))		[0.0330]	[0.0321]	[0.0329]	[0.0345]		[0.0538]	[0.0544]	[0.0630]	[0.0672]
Land Suitability * Year Fixed Effects		-0.0164	-0.0156	-0.0211	-0.0223		0.0258	0.0241	0.0443*	0.0426
		[0.0152]	[0.0146]	[0.0151]	[0.0161]		[0.0192]	[0.0180]	[0.0242]	[0.0260]
Border Department * Year Fixed Effects		-0.0197	-0.0207	-0.0257	-0.0260		0.00231	0.00428	0.0161	0.0157
		[0.0131]	[0.0131]	[0.0158]	[0.0163]		[0.0201]	[0.0198]	[0.0282]	[0.0278]
Maritime Department * Year Fixed Effects		-0.0202*	-0.0206*	-0.0146	-0.0140		-0.0112	-0.0102	-0.0227	-0.0220
		[0.0116]	[0.0115]	[0.0118]	[0.0118]		[0.0185]	[0.0187]	[0.0176]	[0.0181]
Share of Carboniferous Area * Year Fixed Effects		-0.0405	-0.0365	-0.0455	-0.0482		-0.146***	-0.152***	-0.145***	-0.149***
		[0.0319]	[0.0304]	[0.0345]	[0.0361]		[0.0508]	[0.0482]	[0.0522]	[0.0509]
GDP per capita			-0.112	-0.0703				0.207		0.0992
			[0.128]	[0.137]				[0.290]		[0.351]
ρ	-1.787	-3.543**	-3.668**			2.333***	1.141	1.241		
	[1.316]	[1.570]	[1.577]			[0.783]	[1.415]	[1.293]		
σ^2	0.00894***	0.00816***	0.00809***			0.0366***	0.0319***	0.0317***		
	[0.00341]	[0.00273]	[0.00274]			[0.00822]	[0.00770]	[0.00799]		
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.090	0.159	0.166			0.359	0.471	0.474		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	170	170	170	170	170	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.179***	-0.180***				-0.180***	-0.179***
				[0.0485]	[0.0471]				[0.0471]	[0.0485]
1st stage F-stat				13.577	14.602				14.602	13.577
Reduced Form: the dependent variable is										
	Average Value of Extracted Coal (t+2)-(t+3)					Average Value of Extracted Peat (t+2)-(t+3)				
Summer Temperature				-0.488	-0.651				4.675**	4.417
				[1.213]	[1.157]				[2.330]	[2.660]

Note: This table reports panel data regressions that account for spatial autocorrelation where we use a weighting matrix based on the great-circle distance between the department's administrative centers. Columns 1-3 and 6-7 are estimated using the *xsmle* Stata command (Belotti et al., 2013) while Columns 4-5 and 8-10 are estimated using the *xtivreg2* Stata command (Schaffer, 2005). Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table G.6: The Effects of Cholera in 1832, 1849 & 1854 on the number of patents and the Share of Agricultural Hydraulic Patents in the Ten Years following each Pandemic, Accounting for Spatial Autocorrelation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Total Number of Patents					Share of Agricultural Hydraulic Patents				
	Year t+1 to t+10									
Share of Cholera Deaths in Population	2.347	0.413	1.615	27.69*	29.69*	0.186	0.0129	0.0337	4.047**	4.106**
	[9.363]	[9.408]	[8.905]	[15.52]	[15.47]	[0.417]	[0.427]	[0.418]	[1.728]	[1.783]
Deviation from Summer Rainfall in Year (t)		-0.0792	-0.0936	-0.0842	-0.101		0.00241	0.00210	0.00155	0.00104
(Baseline Years (t-1)-(t-25))		[0.0557]	[0.0586]	[0.0596]	[0.0643]		[0.00522]	[0.00537]	[0.00504]	[0.00530]
Land Suitability * Year Fixed Effects		0.0251	0.0264	0.0214	0.0229		0.00179	0.00182	0.00129	0.00134
		[0.0184]	[0.0172]	[0.0189]	[0.0175]		[0.00162]	[0.00159]	[0.00164]	[0.00160]
Border Department * Year Fixed Effects		0.00901	0.00705	0.00338	0.00267		0.000916	0.000907	0.000156	0.000135
		[0.00820]	[0.00826]	[0.00733]	[0.00730]		[0.000920]	[0.000920]	[0.000956]	[0.000957]
Maritime Department * Year Fixed Effects		-0.000429	-0.00294	-0.00264	-0.00373		-0.000680	-0.000698	-0.000927	-0.000959
		[0.0102]	[0.0101]	[0.0102]	[0.00979]		[0.000839]	[0.000840]	[0.000821]	[0.000820]
Share of Carboniferous Area * Year Fixed Effects		0.0850**	0.0779**	0.0792**	0.0697*		0.00342	0.00326	0.00245	0.00217
		[0.0402]	[0.0393]	[0.0391]	[0.0383]		[0.00364]	[0.00373]	[0.00364]	[0.00372]
GDP per capita			0.978**		1.057**			0.0189		0.0315
			[0.417]		[0.478]			[0.0317]		[0.0388]
ρ	0.235	0.263	-0.242			-1.105	-0.803	-0.820		
	[1.196]	[1.125]	[1.179]			[1.612]	[1.456]	[1.464]		
σ^2	0.155***	0.147***	0.142***			0.00134***	0.00130***	0.00130***		
	[0.0301]	[0.0288]	[0.0272]			[0.000246]	[0.000243]	[0.000242]		
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.692	0.708	0.718			0.002	0.032	0.033		
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	255	255	255	255	255	255	255	255	255	255
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.141***	-0.140***				-0.141***	-0.140***
				[0.0303]	[0.0308]				[0.0303]	[0.0308]
1st stage F-stat				21.652	20.788				21.652	20.788
	Reduced Form: the dependent variable is									
	Total Number of Patents					Share of Agricultural Hydraulic Patents				
	Year t+1 to t+10									
Summer Temperature				-3.900	-4.165*				-0.570***	-0.576***
				[2.364]	[2.257]				[0.209]	[0.211]

Note: This table reports panel data regressions that account for spatial autocorrelation where we use a weighting matrix based on the great-circle distance between the department's administrative centers. Columns 1-3 and 6-7 are estimated using the *xsmle* Stata command (Belotti et al., 2013) while Columns 4-5 and 8-10 are estimated using the *xtivreg2* Stata command (Schaffer, 2005). Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

H. Main Regression Results, Accounting for Heterogeneous Treatment Effects

Tables H.1 and H.2 show that our main regression results are also robust to accounting for heterogeneous treatment effects using the two-way fixed effects estimators of de Chaisemartin and D'Haultfoeuille (2020). Here, we define the treatment variable as a dummy variable equal to 1 if the log of the share of cholera deaths in a department population is equal to or greater than the median of the share of cholera deaths in the population variable.

Table H.1: The effects of the cholera in 1849 & 1854 technology adoption in industry in the Year following each Pandemic

	(1) Number of Steam-Powered Machines	(2) Horse Power of Steam-Powered Machines per Worker Year	(3) Number of Steam Generators	(4) Number of Boilers	(5) Average Wage	(6) Number of Workers
Average Treatment Effect	-0.332	-0.641	-0.393	-0.173	-0.778	0.131
	[0.177]*	[0.317]**	[0.199]*	[0.221]	[0.496]	[0.203]
LB CI	-0.680	-1.262	-0.784	-0.607	-1.750	-0.266
UB CI	0.016	-0.019	-0.002	0.260	0.195	0.529
Switchers	31	31	31	31	31	31
Observations	85	85	85	85	85	85

Note: This table presents reports the average effect of treatment on the treated (ATT) for machines, workers and wages in the mining sector in the year following each pandemic accounting for heterogeneous treatment effects using the two-way fixed effects estimators of de Chaisemartin and D'Haultfoeuille (2020). The treatment variable is a dummy variable equal to 1 if the log of the share of cholera deaths in a department population is equal to or greater than the median of the share of cholera deaths in the population variable. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

Table H.2: The effects of the cholera in 1849 & 1854 technology adoption in agriculture in 1852 & 1862

	(1) Number of Day Laborers	(2) Average Wage of Day Laborers	(3) Mechanized Ploughs	(4) Animal-Powered Threshing Machines per Day Laborer	(5) Steam-Powered Threshing Machines
Average Treatment Effect	-0.405	0.0002	0.001	0.090	0.750
	[0.096]***	[0.0001]**	[0.001]	[0.049]*	[0.715]
LB CI	-0.593	8.11E-06	-0.002	-0.007	-0.652
UB CI	-0.217	0.0004	0.004	0.186	2.153
Switchers	31	31	31	31	31
Observations	85	85	85	85	85

Note: This table presents reports the sample average effect of treatment on the treated (ATT) for machines, workers and wages in the agricultural sector in 1852 and 1862 accounting for heterogeneous treatment effects using the two-way fixed effects estimators of de Chaisemartin and D'Haultfoeuille (2020). The treatment variable is a dummy variable equal to 1 if the log of the share of cholera deaths in a department population is equal to or greater than the median of the share of cholera deaths in the population variable. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

I. Mechanism: human capital (with the full set of control variables)

Table I.1: The Effects of the Cholera in 1832, 1849 & 1854 on the Signatures of Wedding Licenses by Spouses Born One to 20 Years after Each Cholera Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	2SLS	2SLS	2SLS
	Signature of Wedding License For Individuals Born 1 to 20 Years after Each Epidemic					
Share of Cholera Deaths in Population	6.739***	5.969***	5.538***	27.87***	25.65***	28.09***
	[1.324]	[1.377]	[1.683]	[4.936]	[5.942]	[6.721]
Male	-0.00913	-0.00906	-0.00906	-0.00930	-0.00903	-0.00914
	[0.00694]	[0.00693]	[0.00693]	[0.00698]	[0.00696]	[0.00697]
Deviation from Summer Rainfall in Year (t)		-0.00309	-0.00310		-0.00289	-0.00281
(Baseline Years (t-1)-(t-25))		[0.00445]	[0.00445]		[0.00455]	[0.00458]
Land Suitability * Year Fixed Effects		-0.00607***	-0.00606***		-0.00594***	-0.00607***
		[0.00165]	[0.00165]		[0.00165]	[0.00166]
Border Department * Year Fixed Effects		-0.00170**	-0.00177**		-0.00256***	-0.00163**
		[0.000782]	[0.000794]		[0.000833]	[0.000811]
Maritime Department * Year Fixed Effects		0.00139**	0.00140**		-0.000771	-0.000590
		[0.000664]	[0.000665]		[0.000935]	[0.000892]
Share of Carboniferous Area * Year Fixed Effects		0.00455	0.00449		0.00218	0.00319
		[0.00311]	[0.00312]		[0.00318]	[0.00312]
GDP per capita			0.0409			-0.478***
			[0.0791]			[0.170]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.190	0.194	0.194	0.179	0.185	0.185
Moran I	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
Moran I p-value	0.246	0.246	0.246	0.246	0.246	0.246
Clusters	3085	3085	3085	3085	3085	3085
Observations	11,953	11,953	11,953	11,953	11,953	11,953
	First stage: the instrumented variable is Share of Cholera Deaths in Population					
Summer Temperature				-0.0826***	-0.0709***	-0.0629***
				[0.00572]	[0.00547]	[0.00461]
1st stage F-stat				208.6	168.1	185.9
	Reduced Form: the dependent variable is Signature of Wedding License For Individuals Born Years t+1 - t+20 after Each Epidemic					
Summer Temperature				-2.301***	-1.819***	-1.767***
				[0.400]	[0.414]	[0.416]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the ability of brides and grooms born one to 20 years after each outbreak to sign their wedding license. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the year-department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table I.2: The Effects of the Cholera in 1832, 1849 & 1854 on the Share of Literate Conscripts Born during the Pandemic, as well as 20 and 35 years afterwards

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Share of Literate Conscripts Born														
	The Year of each Epidemic					20 Years after Each Epidemic					35 Years after Each Epidemic				
Share of Cholera Deaths in Population	0.944	1.637	1.868	8.115***	8.610***	0.430	0.892	1.020	6.836**	7.127**	-0.193	0.0336	0.0421	-0.173	-0.158
	[1.405]	[1.381]	[1.292]	[3.100]	[3.131]	[1.262]	[1.255]	[1.214]	[3.019]	[3.130]	[0.573]	[0.554]	[0.554]	[1.469]	[1.492]
Deviation from Summer Rainfall in Year (t)		0.0219*	0.0190	0.0205	0.0173		-0.000353	-0.00195	-0.00162	-0.00352		0.00717	0.00706	0.00721	0.00711
(Baseline Years (t-1)-(t-25))		[0.0124]	[0.0127]	[0.0128]	[0.0136]		[0.0149]	[0.0150]	[0.0152]	[0.0155]		[0.00527]	[0.00527]	[0.00523]	[0.00523]
Land Suitability * Year Fixed Effects		-0.00256	-0.00221	-0.00338	-0.00302		-0.00224	-0.00205	-0.00300	-0.00279		-0.00257*	-0.00256*	-0.00254*	-0.00253*
		[0.00373]	[0.00343]	[0.00375]	[0.00338]		[0.00247]	[0.00241]	[0.00255]	[0.00245]		[0.00145]	[0.00145]	[0.00143]	[0.00143]
Border Department * Year Fixed Effects		-0.00481**	-0.00498***	-0.00612***	-0.00636***		-0.00322*	-0.00331**	-0.00442***	-0.00456***		-0.00162**	-0.00163**	-0.00158**	-0.00159**
		[0.00183]	[0.00175]	[0.00174]	[0.00166]		[0.00162]	[0.00161]	[0.00156]	[0.00157]		[0.000779]	[0.000781]	[0.000733]	[0.000738]
Maritime Department * Year Fixed Effects		0.000977	0.000792	0.000668	0.000452		0.00155	0.00145	0.00127	0.00114		0.00205**	0.00204**	0.00205**	0.00205**
		[0.00185]	[0.00185]	[0.00184]	[0.00186]		[0.00154]	[0.00158]	[0.00159]	[0.00164]		[0.000893]	[0.000905]	[0.000864]	[0.000874]
Share of Carboniferous Area * Year Fixed Effects		0.0164*	0.0147*	0.0148*	0.0129*		0.0148**	0.0138*	0.0133*	0.0122*		0.00432	0.00425	0.00437	0.00431
		[0.00856]	[0.00799]	[0.00829]	[0.00774]		[0.00716]	[0.00705]	[0.00702]	[0.00697]		[0.00425]	[0.00429]	[0.00415]	[0.00418]
GDP per Capita			0.212***		0.234**			0.117*		0.137*			0.00778		0.00712
			[0.0796]		[0.0944]			[0.0612]		[0.0744]			[0.0266]		[0.0273]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.625	0.685	0.699			0.587	0.646	0.653			0.512	0.596	0.596		
Moran I	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.010	-0.009	-0.009	-0.009	-0.009
Moran I p-value	0.238	0.247	0.229	0.238	0.221	0.198	0.240	0.230	0.228	0.217	0.121	0.182	0.181	0.183	0.182
Clusters	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82
Observations	246	246	246	246	246	246	246	246	246	246	246	246	246	246	246
First stage: the instrumented variable is Share of Cholera Deaths in Population															
Summer Temperature				-0.145***	-0.144***				-0.145***	-0.144***				-0.145***	-0.144***
				[0.0318]	[0.0323]				[0.0318]	[0.0323]				[0.0318]	[0.0323]
1st stage F-stat				20.666	19.799				20.666	19.799				20.666	19.799
Reduced Form: the dependent variable is Share of Literate Conscripts Born															
	The Year of each Epidemic					20 Years after Each Epidemic					35 Years after Each Epidemic				
Summer Temperature				-1.173**	-1.239***				-0.988**	-1.025**				0.0250	0.0228
				[0.497]	[0.461]				[0.453]	[0.449]				[0.217]	[0.220]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the share of literate army conscripts born during the pandemic, as well as 20 and 35 years later. The Bas-Rhin, Haut-Rhin and Moselle departments are not part of France after 1870 and are therefore dropped from the estimation. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table I.3: The Effects of the Cholera in 1832, 1849 & 1854 on the Number of Participants in Courses for Male and Female Adults and Apprentices in 1837, 1850 & 1863

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Number of Participants in Courses for									
	Male Adults and Apprentices 1837-1850-1863					Female Adults and Apprentices 1850-1863				
Share of Cholera Deaths in Population	26.49	19.20	21.42	126.0**	130.6**	29.80	34.15	32.28	-3.720	-19.63
	[23.36]	[24.45]	[24.46]	[57.31]	[59.70]	[27.62]	[29.86]	[28.32]	[88.75]	[89.00]
GDP per capita			2.098*		2.440*			-0.920		-1.267
			[1.188]		[1.323]			[1.678]		[1.675]
Deviation from Summer Rainfall in Year (t)		0.132	0.0981	0.109	0.0697		0.0401	0.0667	0.0857	0.138
(Baseline Years (t-1)-(t-25))		[0.198]	[0.199]	[0.232]	[0.234]		[0.424]	[0.416]	[0.440]	[0.438]
Land Suitability * Year Fixed Effects		0.0600	0.0632	0.0459	0.0493		0.159	0.165	0.198	0.220
		[0.0634]	[0.0606]	[0.0619]	[0.0584]		[0.121]	[0.119]	[0.140]	[0.138]
Border Department * Year Fixed Effects		0.0410	0.0399	0.0219	0.0202		0.00852	0.000866	0.0517	0.0564
		[0.0303]	[0.0304]	[0.0331]	[0.0329]		[0.151]	[0.157]	[0.180]	[0.182]
Maritime Department * Year Fixed Effects		-0.00483	-0.00690	-0.0103	-0.0129		0.183	0.180	0.165	0.156
		[0.0304]	[0.0296]	[0.0297]	[0.0287]		[0.135]	[0.135]	[0.140]	[0.140]
Share of Carboniferous Area * Year Fixed Effects		0.249*	0.231	0.223	0.201		0.284	0.315	0.301	0.350
		[0.145]	[0.142]	[0.142]	[0.137]		[0.376]	[0.390]	[0.364]	[0.381]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.404	0.430	0.438			0.023	0.057	0.059		
Moran I	-0.007	-0.007	-0.007	-0.007	-0.007	-0.012	-0.012	-0.012	-0.012	-0.012
Moran I p-value	0.268	0.268	0.269	0.261	0.261	0.212	0.217	0.217	0.216	0.216
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	255	255	255	255	255	170	170	170	170	170
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.141***	-0.140***				-0.180***	-0.179***
				[0.0303]	[0.0308]				[0.0471]	[0.0485]
1st stage F-stat				21.652	20.788				14.602	13.577
	Reduced Form: the dependent variable is Number of Participants in Courses for									
	Male Adults and Apprentices 1837-1850-1863					Female Adults and Apprentices 1850-1863				
Summer Temperature				-17.75**	-18.32**				0.670	3.509
				[7.848]	[7.826]				[16.31]	[15.97]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the number of participants in courses for male and female adults and apprentices. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table I.4: The Effects of the Cholera in 1832, 1849 & 1854 on Spending on Courses for Male Adults and Apprentices and the Number of Courses for Male and Female Adults and Apprentices in 1837, 1850 & 1863

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
			Spending on Courses for Male Adults and Apprentices 1837-1850-1863					Number of Courses for Male Adults and Apprentices 1837-1850-1863					Number of Courses for Female Adults and Apprentices 1850-1863		
Share of Cholera Deaths in Population	57.53***	53.71**	54.65**	148.6	150.9	0.765	-5.898	-5.073	42.42	44.19	9.979	13.94	13.12	7.052	0.957
	[20.98]	[22.16]	[21.69]	[98.38]	[98.31]	[15.05]	[15.24]	[15.29]	[40.81]	[41.06]	[11.81]	[12.02]	[11.27]	[29.05]	[30.16]
Deviation from Summer Rainfall in Year (t)		0.617	0.603	0.597	0.578		0.171	0.159	0.161	0.146		-0.156	-0.144	-0.147	-0.127
(Baseline Years (t-1)-(t-25))		[0.409]	[0.416]	[0.416]	[0.424]		[0.163]	[0.163]	[0.172]	[0.172]		[0.172]	[0.166]	[0.168]	[0.161]
Land Suitability * Year Fixed Effects		-0.0399	-0.0385	-0.0524	-0.0508		0.0539	0.0550*	0.0475	0.0488		0.0185	0.0212	0.0256	0.0341
		[0.0626]	[0.0622]	[0.0630]	[0.0623]		[0.0335]	[0.0327]	[0.0330]	[0.0319]		[0.0535]	[0.0518]	[0.0522]	[0.0499]
Border Department * Year Fixed Effects		0.0319	0.0314	0.0149	0.0141		0.0341	0.0337	0.0255	0.0248		-0.0323	-0.0357	-0.0244	-0.0227
		[0.0420]	[0.0419]	[0.0464]	[0.0460]		[0.0238]	[0.0239]	[0.0253]	[0.0253]		[0.0511]	[0.0541]	[0.0604]	[0.0608]
Maritime Department * Year Fixed Effects		0.0137	0.0128	0.00876	0.00753		0.00555	0.00478	0.00306	0.00210		0.0627	0.0616	0.0596	0.0559
		[0.0413]	[0.0417]	[0.0409]	[0.0413]		[0.0218]	[0.0217]	[0.0218]	[0.0215]		[0.0575]	[0.0574]	[0.0586]	[0.0596]
Share of Carboniferous Area * Year Fixed Effects		-0.00578	-0.0135	-0.0288	-0.0394		0.0968	0.0899	0.0851	0.0767		0.180	0.194	0.183	0.202
		[0.165]	[0.164]	[0.167]	[0.165]		[0.0845]	[0.0834]	[0.0834]	[0.0818]		[0.142]	[0.149]	[0.137]	[0.144]
GDP per capita			0.884		1.186			0.780		0.935			-0.404		-0.485
			[1.692]		[1.797]			[0.859]		[0.854]			[0.652]		[0.688]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.607	0.615	0.616			0.416	0.438	0.441			0.009	0.054	0.058		
Moran I -0.008	-0.008	-0.008	-0.008	-0.008	-0.007	-0.007	-0.007	-0.007	-0.007	-0.012	-0.012	-0.012	-0.012	-0.0122	-0.012
Moran I p-value	0.239	0.236	0.235	0.237	0.237	0.259	0.257	0.257	0.253	0.255	0.207	0.210	0.209	0.210	0.209
Clusters	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
Observations	255	255	255	255	255	255	255	255	255	255	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population															
Summer Temperature				-0.141***	-0.140***				-0.141***	-0.140***				-0.180***	-0.179***
				[0.0303]	[0.0308]				[0.0303]	[0.0308]				[0.0471]	[0.0485]
1st stage F-stat				21.652	20.788				21.652	20.788				14.602	13.577
Reduced Form: the dependent variable is															
			Spending on Courses for Male Adults and Apprentices 1837-1850-1863					Number of Courses for Male Adults and Apprentices 1837-1850-1863					Number of Courses for Female Adults and Apprentices 1850-1863		
Summer Temperature				-20.94	-21.16				-5.976	-6.198				-1.270	-0.171
				[14.69]	[14.60]				[5.988]	[5.957]				[5.454]	[5.553]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to spending on courses for male adults and apprentices and the number of courses for male and female adults and apprentices. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table I.5: The Effects of the Cholera in 1832, 1849 & 1854 on the Primary School Attendance rate of Boys and Girls out of the Population Age 5-15 in 1837, 1851 & 1856

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	2SLS	2SLS
	Primary School Attendance Rate in Year t				
Share of Cholera Deaths in Population	0.125	1.143	1.327	6.803	7.166
	[1.964]	[1.820]	[1.774]	[5.237]	[5.051]
Deviation from Summer Rainfall in Year (t)		0.012	0.009	0.010	0.007
(Baseline Years (t-1)-(t-25))		[0.0157]	[0.0156]	[0.0154]	[0.0154]
Land Suitability * Year Fixed Effects		-0.00994*	-0.00968*	-0.0107**	-0.0104**
		[0.00530]	[0.00532]	[0.00491]	[0.00495]
Border Department * Year Fixed Effects		-0.00601***	-0.00610***	-0.00703***	-0.00716***
		[0.00208]	[0.00208]	[0.00231]	[0.00225]
Maritime Department * Year Fixed Effects		0.003	0.003	0.003	0.003
		[0.00206]	[0.00204]	[0.00207]	[0.00205]
Share of Carboniferous Area * Year Fixed Effects		0.016	0.014	0.015	0.013
		[0.0113]	[0.0114]	[0.0108]	[0.0109]
GDP per capita			0.173**		0.192**
			[0.0820]		[0.0974]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Within R2	0.654	0.730	0.735		
Moran I	-0.008	-0.007	-0.007	-0.007	-0.007
Moran I p-value	0.231	0.277	0.272	0.272	0.267
Clusters	85	85	85	85	85
Observations	255	255	255	255	255
First stage: the instrumented variable is Share of Cholera Deaths in Population					
Summer Temperature				-0.141***	-0.140***
				[0.0303]	[0.0308]
1st stage F-stat				21.652	20.788
Reduced Form: the dependent variable is Primary School Attendance Rate in Year t					
Summer Temperature				-0.958	-1.005
				[0.845]	[0.811]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to the primary school attendance rate. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

Table I.6: Cholera in 1854 and Total Public Spending on Primary Schooling by Communes, Departments and the Central State

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	OLS	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
								Total Education Spending								
	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total
				Years(t+1)-(t+5)								Years(t+1)-(t+10)				
Share of Cholera Deaths in Population	-5.409	-118.4*	-62.56	-37.42	-90.47*	-103.4	517.8	389.2	-5.314	-72.49**	44.09	31.17	-84.55*	-77.16	101.7	80.52
	[5.868]	[63.06]	[72.59]	[53.52]	[53.07]	[180.5]	[439.3]	[321.6]	[5.439]	[29.30]	[51.92]	[38.33]	[50.41]	[200.6]	[439.3]	[322.1]
Deviation from Summer Rainfall in Year (t)	0.0338	0.0248	-1.140	-0.961	0.398*	-0.0394	-3.625*	-2.788*	0.0434	-0.0630	-2.007*	-1.604**	0.383*	-0.0430	-2.253	-1.815
(Baseline Years (t-1)-(t-25))	[0.104]	[0.351]	[1.036]	[0.754]	[0.215]	[0.616]	[1.959]	[1.432]	[0.0974]	[0.368]	[1.104]	[0.806]	[0.204]	[0.670]	[1.758]	[1.288]
Land Suitability * Year Fixed Effects	0.000390***	0.00225**	0.000402	0.000143	0.000569**	0.00222***	-0.000817	-0.000753	0.000357***	0.00231**	0.00110	0.000649	0.000523**	0.00232***	0.000978	0.000546
	[0.000145]	[0.000889]	[0.000981]	[0.000711]	[0.000231]	[0.000834]	[0.00187]	[0.00137]	[0.000134]	[0.000971]	[0.00119]	[0.000868]	[0.000217]	[0.000884]	[0.00183]	[0.00134]
Border Department * Year Fixed Effects	7.55e-05	-0.000348	0.00107	0.000875	0.000319*	-0.000391	-0.000589	-0.000344	6.76e-05	-0.000266	0.000826	0.000716	0.000294*	-0.000253	0.000662	0.000575
	[7.17e-05]	[0.000287]	[0.000760]	[0.000563]	[0.000164]	[0.000591]	[0.00156]	[0.00115]	[6.75e-05]	[0.000271]	[0.000724]	[0.000544]	[0.000156]	[0.000621]	[0.00139]	[0.00102]
Maritime Department * Year Fixed Effects	9.35e-06	0.000245	-0.00169**	-0.00124**	4.32e-05	0.000239	-0.00192**	-0.00141**	-1.96e-06	0.000255	-0.00175**	-0.00129**	2.95e-05	0.000257	-0.00178**	-0.00131**
	[5.85e-05]	[0.000216]	[0.000717]	[0.000524]	[7.22e-05]	[0.000189]	[0.000819]	[0.000602]	[5.46e-05]	[0.000226]	[0.000763]	[0.000560]	[6.73e-05]	[0.000198]	[0.000752]	[0.000552]
Share of Carboniferous Area * Year Fixed Effects	1.56e-06	0.000821	-0.00128	-0.00103	-0.000131	0.000845	-0.000375	-0.000366	-1.33e-05	0.00103	-0.00176	-0.00141	-0.000136	0.00103	-0.00167	-0.00134
	[0.000273]	[0.00132]	[0.00203]	[0.00147]	[0.000326]	[0.00142]	[0.00226]	[0.00166]	[0.000254]	[0.00147]	[0.00226]	[0.00164]	[0.000293]	[0.00159]	[0.00209]	[0.00153]
GDP per capita	0.630**	-1.069	-9.862***	-7.169***	0.384	-1.026	-8.183***	-5.935***	0.671***	-1.499	-9.750***	-7.189***	0.442*	-1.512	-9.583***	-7.047***
	[0.260]	[1.894]	[1.655]	[1.188]	[0.312]	[1.846]	[2.167]	[1.579]	[0.172]	[1.908]	[1.670]	[1.220]	[0.250]	[1.821]	[1.705]	[1.231]
Constant	19.66***	11.51	-32.77	-20.94	14.66***	12.39***	1.295	4.094**	20.13***	12.85	-0.371	2.501	15.48***	12.58***	3.012	5.397***
	[2.945]	[12.31]	[24.68]	[18.11]	[0.306]	[1.338]	[2.249]	[1.658]	[2.903]	[13.52]	[28.70]	[21.12]	[0.266]	[1.326]	[2.044]	[1.514]
Adjusted R2	0.368	0.280	0.325	0.335					0.417	0.247	0.327	0.342				
Moran I	0.036	0.032	-0.020	-0.016	0.057	0.029	0.006	0.006	0.044	0.012	-0.011	-0.008	0.055	0.013	-0.010	-0.007
Moran I p-value	0.999	0.999	0.309	0.387	1.000	0.997	0.877	0.884	1.000	0.955	0.519	0.604	1.000	0.959	0.536	0.613
Observations	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
First stage: the instrumented variable is Share of Cholera Deaths in Population																
Summer Temperature					0.0210*	0.0210*	0.0210*	0.0210*					0.0210*	0.0210*	0.0210*	0.0210*
					[0.0106]	[0.0106]	[0.0106]	[0.0106]					[0.0106]	[0.0106]	[0.0106]	[0.0106]
1st stage F-stat					3.952	3.952	3.952	3.952					3.952	3.952	3.952	3.952
Reduced Form: the dependent variable is Total Education Spending																
	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total
				Years(t+1)-(t+5)								Years(t+1)-(t+10)				
Summer Temperature					-1.898*	-2.169	10.87	8.166					-1.774*	-1.619	2.134	1.689
					[0.986]	[4.285]	[8.120]	[5.938]					[0.977]	[4.606]	[9.737]	[7.145]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to total spending on primary schooling by communes, departments and the central state. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table I.7: Cholera in 1854 and Public Spending per Inhabitant on Primary Schooling by Communes, Departments and the Central State

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	OLS	OLS	OLS	OLS	OLS	2SLS	2SLS	2SLS	2SLS
								Education Spending per Inhabitant								
	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total
				Years(t+1)-(t+5)								Years(t+1)-(t+10)				
Share of Cholera Deaths in Population	4.481	-3.525**	7.075	7.075	-0.478	-45.37*	-0.787	-0.783	4.803	-6.240**	10.22	10.22	5.161	-62.11*	-3.962	-3.957
	[5.224]	[1.623]	[4.905]	[4.904]	[16.06]	[26.00]	[31.56]	[31.56]	[5.734]	[2.579]	[6.824]	[6.824]	[17.49]	[34.55]	[43.20]	[43.19]
Deviation from Summer Rainfall in Year (t)	0.0851*	-0.0229	-0.195**	-0.195**	0.106*	0.156	-0.161	-0.161	0.100**	-0.0378	-0.279**	-0.279**	0.0988	0.201	-0.218	-0.218
(Baseline Years (t-1)-(t-25))	[0.0469]	[0.0319]	[0.0794]	[0.0794]	[0.0605]	[0.105]	[0.107]	[0.107]	[0.0469]	[0.0432]	[0.107]	[0.107]	[0.0661]	[0.142]	[0.152]	[0.152]
Land Suitability * Year Fixed Effects	0.000109	0.000154***	-0.000236***	-0.000236***	0.000120	0.000242**	-0.000219**	-0.000219**	0.000111	0.000233***	-0.000311***	-0.000311***	0.000111	0.000350**	-0.000281**	-0.000281**
	[7.38e-05]	[4.50e-05]	[5.80e-05]	[5.80e-05]	[9.18e-05]	[0.000102]	[8.86e-05]	[8.86e-05]	[7.65e-05]	[6.59e-05]	[7.90e-05]	[7.90e-05]	[9.72e-05]	[0.000137]	[0.000124]	[0.000124]
Border Department * Year Fixed Effects	5.89e-05**	-5.24e-05**	9.73e-05	9.73e-05	7.31e-05	6.72e-05	0.000120	0.000120	6.41e-05**	-6.37e-05*	0.000128	0.000128	6.31e-05	9.60e-05	0.000169	0.000169
	[2.69e-05]	[2.12e-05]	[6.15e-05]	[6.15e-05]	[5.05e-05]	[7.79e-05]	[8.93e-05]	[8.93e-05]	[2.78e-05]	[3.26e-05]	[8.52e-05]	[8.52e-05]	[5.52e-05]	[0.000103]	[0.000122]	[0.000122]
Maritime Department * Year Fixed Effects	-7.75e-05**	-1.20e-06	-0.000108**	-0.000108**	-7.56e-05***	1.54e-05	-0.000104**	-0.000104**	-9.84e-05***	-9.78e-06	-0.000150**	-0.000150**	-9.86e-05***	1.24e-05	-0.000144**	-0.000144**
	[2.96e-05]	[2.37e-05]	[5.03e-05]	[5.03e-05]	[2.83e-05]	[3.83e-05]	[4.48e-05]	[4.48e-05]	[3.14e-05]	[3.24e-05]	[7.02e-05]	[7.02e-05]	[2.95e-05]	[5.02e-05]	[6.33e-05]	[6.33e-05]
Share of Carboniferous Area * Year Fixed Effects	-0.000195	-0.000116	-0.000286*	-0.000286*	-0.000203*	-0.000181	-0.000298*	-0.000298*	-0.000253**	-0.000150	-0.000376*	-0.000376*	-0.000252**	-0.000237	-0.000398*	-0.000398*
	[0.000120]	[7.34e-05]	[0.000163]	[0.000163]	[0.000111]	[0.000127]	[0.000167]	[0.000167]	[0.000122]	[0.000113]	[0.000220]	[0.000220]	[0.000110]	[0.000180]	[0.000225]	[0.000225]
GDP per capita	0.144	0.0788	-0.386***	-0.386***	0.129	-0.0422	-0.408***	-0.408***	0.150	0.116	-0.558***	-0.558***	0.151	-0.0452	-0.599***	-0.599***
	[0.243]	[0.0895]	[0.120]	[0.120]	[0.231]	[0.132]	[0.121]	[0.121]	[0.240]	[0.139]	[0.168]	[0.168]	[0.232]	[0.184]	[0.172]	[0.172]
Constant	1.812*	3.052**	0.475	0.475	1.521***	0.596***	0.0139	0.0139	2.151*	4.215**	0.861	0.860	2.172***	0.935***	0.0281	0.0282
	[1.048]	[1.225]	[2.081]	[2.081]	[0.168]	[0.134]	[0.144]	[0.144]	[1.151]	[1.616]	[2.806]	[2.806]	[0.168]	[0.183]	[0.200]	[0.200]
Adjusted R2	0.317	0.269	0.398	0.398					0.368	0.272	0.401	0.401				
Moran I	0.017	0.023	0.018	0.018	0.030	0.069	0.028	0.028	0.020	0.021	0.024	0.024	0.020	0.063	0.037	0.037
Moran I p-value	0.976	0.988	0.974	0.974	0.998	1.000	0.995	0.995	0.986	0.983	0.990	0.990	0.984	1.000	0.999	0.999
Observations	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85	85
								First stage: the instrumented variable is Share of Cholera Deaths in Population								
Summer Temperature					0.0210*	0.0210*	0.0210*	0.0210*					0.0210*	0.0210*	0.0210*	0.0210*
					[0.0106]	[0.0106]	[0.0106]	[0.0106]					[0.0106]	[0.0106]	[0.0106]	[0.0106]
1st stage F-stat					3.952	3.952	3.952	3.952					3.952	3.952	3.952	3.952
								Reduced Form: the dependent variable is Education Spending per Inhabitant								
	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total	Communes	Departments	State	Total
				Years(t+1)-(t+5)								Years(t+1)-(t+10)				
Summer Temperature					-0.0100	-0.952**	-0.0165	-0.0164					0.108	-1.303**	-0.0831	-0.0830
					[0.353]	[0.422]	[0.693]	[0.693]					[0.391]	[0.561]	[0.938]	[0.938]

Note: This table presents OLS and IV regressions relating the share of cholera deaths in each department to spending on primary schooling per inhabitant by communes, departments and the central state. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

J. Alternative explanations

In this section, we discuss alternative explanations to our main results. It is indeed possible that during the 19^{th} c., factors such as migration, urbanization, fertility, age at marriage, religiosity or local financial intermediation could have had an impact on technology adoption. As such, our tests are meant to ensure that these factors were neither correlated with the diffusion of the cholera nor with summer temperatures in 1832, 1849 and 1854.

Alternative explanation: Migration and urbanization

Table J.1: Cholera in 1832, 1849 & 1854: Emigrants and Immigrants in 1841, 1851 & 1861

	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) 2SLS	(6) OLS	(7) OLS	(8) OLS	(9) 2SLS	(10) 2SLS
	Stock of Immigrants					Stock of Emigrants				
Share of Cholera Deaths in Population	13.59	11.93	11.02	-26.20	-28.14	10.42	9.986	9.660	8.748	8.127
	[8.534]	[8.959]	[8.932]	[20.47]	[20.99]	[6.741]	[7.009]	[6.934]	[16.07]	[15.84]
Deviation from Summer Rainfall in Year (t)		-0.0908	-0.0808	-0.0782	-0.0664		0.00223	0.00585	0.00264	0.00642
(Baseline Years (t-1)-(t-25))		[0.0959]	[0.0899]	[0.0892]	[0.0854]		[0.0518]	[0.0517]	[0.0502]	[0.0501]
Land Suitability * Year Fixed Effects		0.0280**	0.0266**	0.0328***	0.0313***		-0.0186**	-0.0191**	-0.0185**	-0.0190**
		[0.0108]	[0.0104]	[0.0109]	[0.0104]		[0.00812]	[0.00791]	[0.00794]	[0.00767]
Border Department * Year Fixed Effects		0.0122	0.0129	0.0200*	0.0211*		0.0115	0.0118*	0.0118	0.0121
		[0.0123]	[0.0122]	[0.0116]	[0.0114]		[0.00702]	[0.00701]	[0.00762]	[0.00757]
Maritime Department * Year Fixed Effects		-0.0172**	-0.0164**	-0.0153*	-0.0144*		-0.00933	-0.00907	-0.00927	-0.00899
		[0.00785]	[0.00765]	[0.00794]	[0.00776]		[0.00831]	[0.00843]	[0.00798]	[0.00807]
Share of Carboniferous Area * Year Fixed Effects		-0.0210	-0.0140	-0.0119	-0.00360		0.0193	0.0218	0.0196	0.0222
		[0.0278]	[0.0270]	[0.0272]	[0.0267]		[0.0217]	[0.0214]	[0.0217]	[0.0212]
GDP per capita			-0.863**		-0.985**			-0.312		-0.316
			[0.361]		[0.455]			[0.265]		[0.258]
Within R2	0.023	0.097	0.117			0.057	0.149	0.155		
Moran I	-0.008	-0.008	-0.008	-0.008	-0.008	-0.009	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.212	0.225	0.227	0.215	0.213	0.193	0.200	0.195	0.196	0.200
Clusters	81	81	81	81	81	81	81	81	81	81
Observations	243	243	243	243	243	243	243	243	243	243
R-squared	0.023	0.097	0.117	-0.021	-0.007	0.057	0.149	0.155	0.149	0.154
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes	No	No	Yes	No	Yes
First stage: the instrumented variable is Share of Cholera Deaths in Population										
Summer Temperature				-0.145***	-0.144***				-0.145***	-0.144***
				[0.0320]	[0.0326]				[0.0320]	[0.0326]
1st stage F-stat				20.378	19.524				20.378	19.524
Reduced Form: the dependent variable is										
	Stock of Immigrants					Stock of Emigrants				
Summer Temperature				3.790	4.052				-1.265	-1.170
				[3.053]	[3.027]				[2.357]	[2.330]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the stock of emigrants and immigrants in each department. Constant not reported. Robust standard errors clustered at the department level. Data on migrants are missing for the Bas-Rhin, Haut-Rhin, Meurthe and Moselle departments. $^{***}p < 0.01,^{**} p < 0.05,^{*} p < 0.1$.

The potential effects of labor scarcity on migration have opposite signs. On the one hand, labor scarcity entails higher wages and may attract immigrants. On the other hand, the adoption of new technology may lower wages and hence trigger emigration. It may also be the case that individuals would leave areas hit by the cholera to escape death and would not come back.

Table J.2: Cholera in 1832, 1849 & 1854: Urban Population in 1841, 1851 & 1861

	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) 2SLS
	Share of Urban Population				
Share of Cholera Deaths in Population	-0.378	-0.0384	-0.0995	-5.366	-5.287
	[1.120]	[1.190]	[3.968]	[3.375]	[3.323]
Department and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Geographic Controls * Year Fixed Effects	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes
Within R2	0.345	0.375	0.370		
Moran I	-0.007	-0.007	-0.007	-0.007	-0.007
Moran I p-value	0.272	0.272	0.266	0.261	0.258
Clusters	85	85	85	85	85
Observations	255	255	255	255	255
First stage: the instrumented variable is Share of Cholera Deaths in Population					
Summer Temperature				-0.141***	-0.140***
				[0.0303]	[0.0308]
1st stage F-stat				21.652	20.788
Reduced Form: the dependent variable is Share of Urban Population					
Summer Temperature				0.756*	0.742*
				[0.415]	[0.410]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the share of the urban population in each department. Constant not reported. Robust standard errors clustered at the department level. Data on migrants are missing for the Bas-Rhin, Haut-Rhin, Meurthe and Moselle departments. $^{***}p < 0.01, ^{**} p < 0.05, ^{*} p < 0.1$.

We rely on the data reconstructed by Daudin et al. (2019) on the share of the urban population and on the movements of the French population every decade during the 19^{th} century. They enable us to assess the effect of the 1832, 1849 and 1854 pandemics in each department on the stock of emigrants, i.e., the share of individuals who left their birth department, and on the stock of immigrants, i.e., the share of individuals who were living in a department other than their birth department, in 1841, 1851 and 1861.[19]

[19] These are measures of long-term migration, which is a characteristic of the 19^{th} c., as opposed to short-term migration which had been documented in agriculture in France since the middle ages (Châtelain, 1977). However there is no reason to think that short-term migration would have an impact on technology adoption in the wake of the cholera outbreaks as short-term migration occurred every year during harvest. It is unlikely to be correlated with high summer temperatures in specific departments only in 1832, 1849 and 1854. Finally it is unclear why short-term migration would lead to more technology adoption in agriculture and less in industry.

In Table J.1, the share of cholera deaths in the population has a negative and mostly insignificant effect on the stock of immigrants. It has a positive impact on the share of emigrants in Table J.1, although this effect is never significant. Furthermore, in Table J.2, the share of cholera deaths in the population has a negative but insignificant impact on the share of the urban population in each department. As such, while it bears repeating that our results do not in any way suggest that migration and urbanization did not play a role in technology adoption and innovation, they nonetheless show that migration and urbanization were not correlated with the spread of cholera and therefore cannot drive our main results.

Alternative explanation: Religiosity

To account for research (e.g., Bentzen, 2019) that has highlighted the link between natural disasters (such as pandemics) and religiosity, we explore whether the cholera outbreaks could be correlated with changes in religiosity and potentially with a deeper cultural shift that could delay or accelerate technology adoption and innovation. For this purpose, we use data from the *Statistique Annuelle de la France* on the shares of seminarians and of religious community members in the population. The choice of these two measures of Catholic religiosity is motivated by the importance of the Church in the educational system in 19^{th} c. France and by the fact that the French population remained overwhelmingly Catholic, in spite of its political independence from the clergy (Franck and Johnson, 2016; Squicciarini, 2020).[20]

Table J.3 assesses the effect of the cholera pandemics on religiosity through two proxies: the shares of seminarians and of religious community members in the population. The results show the pandemics had a positive and significant but quantitatively small effect on the share of seminarians in the population, and no significant impact on the share of members of religious communities. Overall, these results suggest that religiosity was not really affected by the cholera pandemics and cannot therefore explain their impact on technology adoption.

[20]The 1861 census indicates that about 2% of the French population was Protestant and about 0.2% was Jewish.

Table J.3: Cholera in 1832, 1849 & 1854: Seminarians and Religious Community Members in 1841, 1851 & 1856

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	OLS	OLS	OLS	2SLS	2SLS	OLS	OLS	OLS	2SLS	2SLS
	Share of Seminarians in Population 1841-1851-1856					Share of Religous Community Members in Population 1841-1851-1856				
Share of Cholera Deaths in Population	0.00438	0.00371	0.00257	0.0321**	0.0302**	-0.00950	-0.0104	-0.0104	0.0158	0.0161
	[0.00626]	[0.00579]	[0.00603]	[0.0138]	[0.0136]	[0.00898]	[0.00875]	[0.00875]	[0.0279]	[0.0284]
Deviation from Summer Rainfall in Year (t)		-8.01e-05	-7.00e-05	-9.36e-05*	-8.48e-05		-0.000364***	-0.000364***	-0.000377***	-0.000379***
(Baseline Years (t-1)-(t-25))		[5.56e-05]	[5.17e-05]	[5.36e-05]	[5.27e-05]		[0.000136]	[0.000135]	[0.000109]	[0.000110]
Land Suitability * Year Fixed Effects		1.44e-05*	1.36e-05*	1.15e-05	1.09e-05		5.35e-05***	5.35e-05***	5.08e-05***	5.09e-05***
		[7.69e-06]	[6.92e-06]	[8.78e-06]	[8.58e-06]		[1.77e-05]	[1.77e-05]	[1.78e-05]	[1.79e-05]
Border Department * Year Fixed Effects		3.92e-06	4.53e-06	1.93e-08	6.54e-07		1.01e-05	1.01e-05	6.50e-06	6.38e-06
		[5.73e-06]	[5.52e-06]	[6.14e-06]	[6.03e-06]		[1.04e-05]	[1.05e-05]	[1.24e-05]	[1.25e-05]
Maritime Department * Year Fixed Effects		3.82e-06	4.28e-06	2.27e-06	2.69e-06		-7.65e-06	-7.64e-06	-9.08e-06	-9.16e-06
		[5.16e-06]	[5.17e-06]	[5.30e-06]	[5.19e-06]		[1.25e-05]	[1.25e-05]	[1.07e-05]	[1.08e-05]
Share of Carboniferous Area * Year Fixed Effects		6.38e-07	6.54e-06	-4.68e-06	3.76e-07		9.38e-05	9.39e-05	8.89e-05**	8.80e-05**
		[2.03e-05]	[1.94e-05]	[2.15e-05]	[2.12e-05]		[5.78e-05]	[5.88e-05]	[4.36e-05]	[4.42e-05]
GDP per capita			-0.000742***		-0.000613**			-7.98e-06		0.000115
			[0.000278]		[0.000295]			[0.000601]		[0.000614]
Department and Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Within R2	0.602	0.624	0.642			0.415	0.481	0.481		
Moran I	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008	-0.008
Moran I p-value	0.203	0.210	0.210	0.208	0.209	0.235	0.238	0.238	0.236	0.237
Clusters	85	85	85	85	85	85	85	85	85	85
Observations	252	252	252	252	252	252	252	252	252	252
	First stage: the instrumented variable is Share of Cholera Deaths in Population									
Summer Temperature				-0.136***	-0.135***				-0.136***	-0.135***
				[0.0297]	[0.0301]				[0.0297]	[0.0301]
1st stage F-stat				21.163	20.191				21.163	20.191
	Reduced Form: the dependent variable is									
	Share of Seminarians in Population 1841-1851-1856					Share of Religious Community Members in Population 1841-1851-1856				
Summer Temperature				-0.00438***	-0.00408**				-0.00215	-0.00218
				[0.00160]	[0.00168]				[0.00359]	[0.00356]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the share of seminarians and religious community members in the population. Data are missing for the Meurthe-et-Moselle department in 1854 and for the Seine department in 1849 and 1854. Constant not reported. Robust standard errors clustered at the year-department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Alternative explanation: Fertility and age at marriage

To assess this potential alternative explanation for our results, we rely on on the data from the *Statistique Annuelle de la France* to compute the crude birth rate, which is the ratio of the number of births to the population of each department. While this is obviously a crude measure of fertility, it is less likely to be biased than other indices. Furthermore, we rely on the *Enquête des 3000 familles* dataset to analyze the age at marriage for individuals born one to 20 years after each epidemic.

Table J.4: The Effects of the Cholera in 1832, 1849 & 1854 on the Crude Birth Rate in the Decade after each Pandemic

	(1) OLS	(2) OLS	(3) OLS	(4) 2SLS	(5) 2SLS
	Crude Birth Rate - Year t+1 to t+10				
Share of Cholera Deaths in Population	-2.259***	-1.834**	-1.903**	-0.798	-0.916
	[0.760]	[0.847]	[0.803]	[3.499]	[3.508]
Deviation from Summer Rainfall in Year (t)		-0.00638	-0.00533	-0.00659	-0.00559
(Baseline Years (t-1)-(t-25))		[0.00968]	[0.00955]	[0.00914]	[0.00888]
Land Suitability * Year Fixed Effects		-0.00273*	-0.00283*	-0.00287	-0.00296*
		[0.00159]	[0.00154]	[0.00175]	[0.00170]
Border Department * Year Fixed Effects		-0.00341**	-0.00337**	-0.00359***	-0.00355***
		[0.00141]	[0.00142]	[0.00120]	[0.00121]
Maritime Department * Year Fixed Effects		0.00318***	0.00325***	0.00313***	0.00319***
		[0.000974]	[0.000955]	[0.000929]	[0.000908]
Share of Carboniferous Area * Year Fixed Effects		-0.00708*	-0.00650	-0.00733	-0.00677
		[0.00405]	[0.00409]	[0.00450]	[0.00460]
GDP per capita			-0.0652*		-0.0621
			[0.0352]		[0.0415]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	Yes	Yes
Geographic Controls	No	Yes	Yes	Yes	Yes
GDP per capita	No	No	Yes	No	Yes
Within R2	0.381	0.428	0.430		
Moran I	-0.006	-0.006	-0.006	-0.006	-0.006
Moran I p-value	0.338	0.353	0.354	0.353	0.354
Clusters	85	85	85	85	85
Observations	255	255	255	255	255
First stage: the instrumented variable is Share of Cholera Deaths in Population					
Summer Temperature				-0.141***	-0.140***
				[0.0303]	[0.0308]
1st stage F-stat				21.652	20.788
Reduced Form: the dependent variable is Crude Birth Rate - Year t+1 to t+10					
Summer Temperature				0.112	0.128
				[0.505]	[0.504]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the crude birth rate in the decade following each oubtreak. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01,^{**}p < 0.05,^{*}p < 0.1$.

Given that the fertility decline in France had begun in the late 18^{th} c. (Galor, 2011; de la Croix and Perrin, 2018; Daudin et al., 2019), it is not clear whether the drop in population would have an impact on fertility rates and on the age at marriage and through these channels, on technology adoption.

Table J.4 finds a negative impact of the 1832, 1849 and 1854 pandemics on the crude birth rate over the ten years after each pandemic, although it is only significant in the OLS regressions. Moreover, Table J.5 reports a negative but insignificant effect on the age at marriage for individuals born one to 20 years after each epidemic. Overall, it does not seem that the correlation between fertility, nuptiality patterns and cholera epidemics would be strong enough to explain technology adoption.

Table J.5: Cholera in 1832, 1849 & 1854: Age at Marriage of Spouses Born One to 20 Years after Each Cholera Pandemic

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	2SLS	2SLS	2SLS
	Age at Marriage For Individuals Born 1 to 20 Years after Each Epidemic					
Share of Cholera Deaths in Population	-28.83	-30.06	-28.11	-81.61	-84.78	-91.25
	[19.19]	[19.91]	[23.22]	[59.81]	[71.60]	[80.95]
Male	-0.0436	-0.0452	-0.0452	-0.0432	-0.0453	-0.0450
	[0.0839]	[0.0840]	[0.0840]	[0.0834]	[0.0835]	[0.0835]
Deviation from Summer Rainfall in Year (t)		-0.0180	-0.0180		-0.0186	-0.0188
(Baseline Years (t-1)-(t-25))		[0.0552]	[0.0552]		[0.0546]	[0.0548]
Land Suitability * Year Fixed Effects		0.0175	0.0175		0.0172	0.0175
		[0.0194]	[0.0194]		[0.0193]	[0.0193]
Border Department * Year Fixed Effects		0.0110	0.0113		0.0133	0.0109
		[0.00966]	[0.00978]		[0.0102]	[0.00975]
Maritime Department * Year Fixed Effects		-0.00134	-0.00138		0.00467	0.00419
		[0.00799]	[0.00799]		[0.0107]	[0.0103]
Share of Carboniferous Area * Year Fixed Effects		-0.00163	-0.00136		0.00495	0.00228
		[0.0353]	[0.0353]		[0.0358]	[0.0352]
GDP per capita			-0.184			1.269
			[1.137]			[2.109]
Department- & Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Deviation from Summer Rainfall	No	Yes	Yes	No	Yes	Yes
Geographic Controls	No	Yes	Yes	No	Yes	Yes
GDP per capita	No	No	No	No	No	Yes
Moran I	0.000	0.000	0.000	0.000	0.000	0.000
Moran I p-value	0.242	0.242	0.242	0.242	0.242	0.242
R-squared	0.047	0.047	0.047	0.046	0.047	0.047
Observations	11,953	11,953	11,953	11,953	11,953	11,953
First stage: the instrumented variable is Share of Cholera Deaths in Population						
Summer Temperature				-0.0826***	-0.0709***	-0.0629***
				[0.00572]	[0.00547]	[0.00461]
1st stage F-stat				208.63	168.10	185.95
Reduced Form: the dependent variable is Age at Marriage For Individuals Born 1 to 20 Years after Each Epidemic						
Summer Temperature				6.738	6.011	5.739
				[4.981]	[5.114]	[5.130]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the age at marriage of brides and grooms born one to 20 years after each outbreak. Geographic controls for departments, which are interacted with year-fixed effects, include their land suitability, their share of carboniferous area and dummies for border and maritime departments. Constant not reported. Robust standard errors clustered at the year-department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Alternative explanation: Local financial intermediation

Because of the relationship between local access to finance and economic growth (e.g., Gennaioli et al., 2014), we analyze whether labor scarcity fostered technological adoption through the presence of local banks. We take advantage of the successive yearly issues of the *Rapport sur les Caisses d'Epargne* after 1835. This official publication of the French state provides data on the deposits in each savings bank of each department that we normalize by the department's population.

Table J.6: Cholera in 1849 & 1854: average amount of deposits per capita in the five years following each pandemic

	(1)	(2)	(3)	(4)	(5)
	OLS	OLS	OLS	2SLS	2SLS
	Deposits per Capita - Average Years t+1 to t+5				
Share of Cholera Deaths in Population	-2.159	-1.333	-0.620	4.753	10.04
	[3.526]	[3.554]	[3.358]	[9.755]	[10.47]
Deviation from Summer Rainfall in Year (t)		0.0323	0.0221	0.0250	0.00741
(Baseline Years (t-1)-(t-25))		[0.0417]	[0.0404]	[0.0478]	[0.0499]
Land Suitability * Year Fixed Effects		0.00357	0.00125	-0.00270	-0.0101
		[0.0178]	[0.0201]	[0.0255]	[0.0265]
Border Department * Year Fixed Effects		-0.00988	-0.00696	-0.0168	-0.0184
		[0.0125]	[0.0132]	[0.0211]	[0.0217]
Maritime Department * Year Fixed Effects		0.00851	0.00945	0.0113	0.0144
		[0.0130]	[0.0133]	[0.0148]	[0.0153]
Share of Carboniferous Area * Year Fixed Effects		0.00391	-0.00784	0.00112	-0.0150
		[0.0484]	[0.0473]	[0.0578]	[0.0599]
GDP per capita			0.350*		0.421*
			[0.194]		[0.232]
Department- and Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Within R2	0.547	0.558	0.574		
Moran I	-0.010	-0.009	-0.009	-0.009	-0.010
Moran I p-value	0.316	0.323	0.321	0.317	0.309
Clusters	85	85	85	85	85
Observations	170	170	170	170	170
First stage: the instrumented variable is Share of Cholera Deaths in Population					
Summer Temperature				-0.180***	-0.179***
				[0.0471]	[0.0485]
1st stage F-stat				14.602	13.577
Reduced Form: the dependent variable is Deposits per Capita - Average Years t+1 to t+5					
Summer Temperature				-0.856	-1.796
				[1.225]	[1.351]

Note: This table presents OLS and IV regressions relating the share of cholera deaths to the average amount of deposits per capita in the five years following each outbreak. Constant not reported. Robust standard errors clustered at the department level. $^{***}p < 0.01, ^{**}p < 0.05, ^{*}p < 0.1$.

Table J.6 reports the impact of the cholera pandemics on the amount of deposits per capita in the savings banks of each department averaged over the five year period which followed each pandemic. The effect is insignificant in all the specifications. These results thus suggest that local financial development was not correlated with the cholera outbreaks and cannot therefore drive our results pertaining to technology adoption and innovation.

H. Historical sources

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